CHAPTER 4.0
ENVIRONMENTAL CONSEQUENCES

4.0 ENVIRONMENTAL CONSEQUENCES

4.1 INTRODUCTION

This chapter presents the environmental consequences of the development actions proposed under the alternatives described in Chapter 2. The six alternatives addressed below are analyzed.

Alternative A (Proposed Action) would include the development of 1,491 new natural gas production wells, with associated access roads, water-supply pipelines, and gathering lines within the Riverbend, Wilkin Ridge, and Gate Canyon areas (see Maps 2 and 3). The Bureau of Land Management (BLM) has identified Alternative A (Proposed Action) as the preferred alternative.

Alternative B would include the drilling of 1,114 new gas production wells. Alternative B would offer more protection for sensitive resource and land use issues in the project area identified during public and agency scoping. Under Alternative B, natural gas development on federal leases would be implemented in a phased manner through surface-disturbance restrictions imposed by the BLM. The maximum new annual surface disturbance would be limited to approximately 485 acres per year on federal land.

Alternative C was developed to analyze the effects of a maximum development scenario in the project area, and analyzes the impact of the development of 1,887 new wells.

Alternative D (No Action) analyzes the effects of taking no action to implement the Proposed Action or other action alternatives, but assumes that natural gas development would continue on exploratory drilling projects previously approved by BLM, and would likely continue on State of Utah and private lands, subject to the approval of the Utah Division of Oil, Gas, and Mining (UDOGM) or the appropriate private landowner. For purposes of analysis in this final environmental impact statement (EIS), it is assumed that under the No Action Alternative, approximately 368 new wells would be developed within the project area in the next 15 years.

Alternative E was developed to analyze the effects of the use of directional drilling throughout the project area, and analyzes the impact of 1,114 new wells drilled from 328 new pads. Alternative E, like Alternative B, would also offer more protection for sensitive resource and land use issues in the project area identified during public and agency scoping.

Alternative F (Agency Preferred Alternative) was developed in response to comments received during the public comment period. It was designed to incorporate directional drilling to reduce surface impacts while still allowing the proponent to use some vertical drilling. It avoids development in the Green River floodplain and Nine Mile Canyon, and restricts evaporative pond acreage for water disposal. Alternative F analyzes the impact of drilling 1,298 wells from a total of 575 well pads.

This programmatic EIS provides a large-scale, "big-picture" level of analysis, and in most cases the exact locations of projected development and other changes are not known at this time. Because of the programmatic nature of this document, analysis requires that well locations be estimated based on existing foreseeable development scenarios. Once this project is implemented, individual well siting and associated effects would be determined through site-specific clearances associated with the Application to Drill (APD) phase of well development. These clearances would include site-specific biological, cultural, and paleontological surveys prior to construction, as directed by the BLM (see Section 2.1, Management Actions Common to All Alternatives). Necessary mitigation requirements would be identified at that time.

For the analysis, BLM staff used existing data, appropriate scientific methodologies, and professional judgment. The analysis takes into account the applicant-committed measures described in Chapter 2. This analysis was done using the best-available information for a programmatic analysis of the impacts of development alternatives within the project area. This includes but is not limited to landscape-level data such as gap analysis program (GAP) level vegetation data, Soil Survey Geographic Database (SSURGO) soils data, and BLM Vernal Field Office (FO) information on wildlife habitat boundaries. Impacts from actions to be carried out under more than one alternative are discussed under the first applicable alternative. This discussion is then referenced under the other pertinent alternatives.

4.1.1 Analytical Assumptions

The following are the general assumptions used for assessment under all alternatives. Assumptions associated with a given resource (e.g., wildlife habitat) are included within the alternative discussion for that resource.

- Short-term impacts are those that would last fewer than 5 years.
- Long-term impacts are those that would last 5 years or more.
- All decisions, projects, activities, and mitigation for the alternatives would be completed as described in Chapter 2, Table 2-1 and Section 2.2.9, Section 2.3.9, Section 2.4.9, Section 2.5.9, and Section 2.6.9.
- Acreages were calculated using geographic information system (GIS) technology; there may be slight variations in total acres between resources. These variations are negligible and will not affect analysis.
- All acreages and percentages presented in this chapter pertain to all lands within the project area (rather than only BLM lands), unless otherwise specified.
- Reasonable access to state lands across BLM lands would be provided under all alternatives as may be required by law.
- Approximately 0.5 mile is the distance over which construction noise would remain greater than 55 decibels (dBA), the level the U.S. Environmental Protection Agency (EPA) has suggested for annoyance of humans (EPA 1974). At distances over 0.5 mile, the noise of the construction would attenuate to a level below 55 dBA (EPA 1971).

4.1.2 Types of Impacts to be Addressed

Impacts are defined as modifications to the existing environment brought about by implementing an alternative. Impacts can be beneficial or adverse, result from the action directly or indirectly, and can be long-term, short-term, temporary, or cumulative in nature. This analysis provides a quantitative or qualitative comparison (dependant on available data and nature of the impact) between alternative impacts as well as establishing the severity of those impacts in the context of the existing environment. It also includes specifically required disclosures under National Environmental Policy Act (NEPA), including the irreversible (resource use or environment cannot be restored) and irretrievable (resource value is lost until the environment is restored) commitment of resources and the impact of the project's short-term resource use and the long-term productivity of the project area.

Direct impacts are attributable to implementation of an alternative that affects a specific resource, and generally occur at the same time and place. Indirect impacts can result from one resource affecting another (e.g., soil erosion and sedimentation affecting water quality) or can occur later in time or removed in location, but are still reasonably foreseeable. Long-term impacts are those that would substantially remain for many years or for the life of the project. Temporary impacts are short-term or ephemeral changes to the environment that return to the original condition once the activity is stopped, such as air pollutant emissions caused by earthmoving equipment during construction. Short-term impacts result in changes to the environment that are stabilized or mitigated rapidly and without long-term impacts. Cumulative impacts are the result of past, present, and reasonably foreseeable future actions by federal, state, and local governments, private individuals, and entities in or near the project area. Cumulative impacts could result from individually minor but collectively significant actions that take place over time.

This analysis was conducted using the best available information. This includes but is not limited to landscape level data such as GAP-level vegetation data, SSURGO soils data, and BLM information on wildlife habitat boundaries. Additional clearances (including cultural resource surveys, Treatened and Endangered Species [TES] surveys, etc.) will be required to complete the necessary on-site review prior to implementation of any part of the proposed activities.

Certain resources and resource uses would not be impacted by any of the alternatives presented in Chapter 2, and therefore they are not brought forward for detailed analysis. Appendix A summarizes each of the resources and resource uses that would and would not be impacted by the project alternatives.

4.1.2.1 Unavoidable Adverse Impacts

This section (and throughout the chapter) addresses impacts that cannot be avoided by the application of mitigation measures. Mitigation measures may consist of existing regulatory requirements or other potential mitigation (including measures outside the jurisdiction of the lead or cooperating agency). This section therefore indicates the effectiveness of proposed mitigation measures for each resource, and helps the decision maker identify those mitigation measures to be included in a ROD.

4.1.2.2 IRRETRIEVABLE AND IRREVERSIBLE COMMITMENTS OF RESOURCES

Irreversible and irretrievable commitments of resources (in other words, irreversible and irretrievable impacts) are disclosed in this section for each resource. Irreversible impacts are those impacts that would result in changes to the environment that cannot be reversed, reclaimed, or repaired. An example of an irreversible impact would be the removal of natural gas from the project area. Once the in-place gas reserves present in the project area are removed, they cannot be replaced or reclaimed. Irretrievable impacts are those impacts that result in the temporary loss or degradation of the resource value until reclamation is successfully completed.

4.1.2.3 RELATIONSHIP OF SHORT-TERM USES TO LONG-TERM PRODUCTIVITY

This section describes how the short-term project use would affect the long-term productivity of a given resource.

4.1.3 CONSIDERATION OF SUPPLEMENTAL AUTHORITIES

The BLM's NEPA Handbook (H-1790-1-2008) requires that all EISs consider certain topics, which the BLM refers to as “Supplemental Authorities to be Considered.” These elements are presented in Table 4-1, followed by corresponding relevant authorities and the status of how the topic is addressed in this document.

Table 4-1. Supplemental Authorities to be Considered

Critical Element	Relevant Authority	Status
Air Quality	The Clean Air Act, as amended (42 U.S.C. 7401 et seq.)	Addressed in Section 4.2, Air Quality
Cultural Resources	National Historic Preservation Act, as amended (16 U.S.C. 470)	Addressed in Section 4.3, Cultural Resources
Environmental Justice	E.O. 12898, “Environmental Justice” February 11, 1994	There are no identified issues with environmental justice related to any of the alternatives
Fish Habitat	Magnuson-Stevens Act Provision: Essential Fish Habitat (EFH): Final Rule (50 CFR 600; 67 *Federal Register* [FR] 2376, January 17, 2002)	Addressed in Section 4.12, Special Status Species
Forests and Rangelands	Healthy Forests Restoration Act of 2003 (P.L. 108-148)	Addressed in Section 4.6, Livestock Management, and Section 4.13, Vegetation
Floodplains	E.O. 11988, as amended, Floodplain Management, 5/24/77	Addressed in Section 4.15, Water Resources
Migratory Birds	Migratory Bird Treaty Act of 1918, as amended (16 United States Code [USC] 703 et seq.) E.O. 131186, “Responsibilities of Federal Agencies to Protect Migratory Birds“ January 10, 2001	Addressed in Section 4.12, Special Status Species
Native American Religious Concerns	American Indian Religious Freedom Act of 1978 (42 U.S.C. 1996)	Addressed in Sections 4.9, Socioeconomics, and 4.3, Cultural Resources

Table 4-1. Supplemental Authorities to be Considered

Critical Element	Relevant Authority	Status
Threatened or Endangered Species	Endangered Species Act of 1973 as amended (16 U.S.C. 1531)	Addressed in Section 4.12, Special Status Species
Wastes (hazardous or solid)	Resource Conservation and Recovery Act of 1976 (42 U.S.C. 6901 et seq.) Comprehensive Environmental Response, Compensation, and Liability Act of 1980 as amended (42 U.S.C. 9615)	There are no identified issues with wastes (hazardous or solid) related to any of the alternatives
Water Quality (drinking/ground)	Safe Drinking Water Act, as amended (42 U.S.C. 300f et seq.) Clean Water Act of 1977 (33 U.S.C. 1251 et seq.)	Addressed in Section 4.15, Water Resources
Wetlands/Riparian Zones	E.O. 11990 Protection of Wetlands 5/24/77	Addressed in Section 4.15, Water Resources
Wild and Scenic Rivers	Wild and Scenic Rivers Act, as amended (16 U.S.C. 1271)	Addressed in Section 4.11, Special Designations
Wilderness	Federal Land Policy and Management Act of 1976 (43 USC 1701 et seq.); Wilderness Act of 1964 (16 USC 1131 et seq.)	There are no designated wilderness or Wilderness Study Areas (WSAs) in the project area

This analysis was conducted using the best-available information. This includes but is not limited to landscape level data such as GAP-level vegetation data, SSURGO soils data, and BLM information on wildlife habitat boundaries. Additional clearances (including cultural resource surveys, TES surveys, etc.) will be required to complete the necessary on-site review prior to implementation of any part of the proposed activities.

Certain resources and resource uses would not be impacted by any of the alternatives presented in Chapter 2, and therefore they are not brought forward for detailed analysis. Appendix A summarizes each of the resources and resource uses that would and would not be impacted by the project alternatives.

4.1.4 ENVIRONMENTAL CONSEQUENCES OF ALTERNATIVES

The following sections present the impacts to each of the identified resources from each of the alternatives discussed in Chapter 2. Existing conditions concerning each resource are described in Chapter 3.

4.2 AIR QUALITY

Air quality impacts were evaluated for both near-field and far-field impacts. Near-field impacts quantify the direct and indirect local impacts created by each alternative, while far-field impacts describe the potential impacts at locations a significant distance away from the project area.

4.2.1 NEAR-FIELD AIR QUALITY

The near-field analysis considered potential impacts to air quality that may occur within 3 miles (5 km) of the project area. The Near-Field Air Quality Technical Support Document (Appendix H) presents a complete description of the project emissions, the modeling protocol, and modeling results. There are 2 types of activities associated with each alternative that were evaluated for impacts to air quality; development and operations. Development includes: the construction of individual well pads and associated access roads, drilling, and completion activities. Operations include the running of equipment associated with production and the associated truck traffic.

Near-field dispersion modeling was performed for Alternatives A through E to evaluate both development and operational impacts. The AERMOD model (Version 07026) was used to predict the impacts of pollutant emissions for comparison to the national ambient air quality standards (NAAQS) for carbon monoxide (CO), sulfur dioxide (SO_2), particulate matter 10 microns (PM_{10}), and particulate matter 2.5 microns ($PM_{2.5}$). Because development activities are temporary and short_term in nature, comparisons of impacts from development activities to prevention of significant deterioration (PSD) increments are not appropriate and were therefore not made. Impacts from operational activities were compared to PSD increments when appropriate. AERMOD was used to predict impacts of nitrogen oxide (NO_x) emissions as a surrogate for nitrogen dioxide (NO_2). The meteorological data used were from surface and upper air stations developed for the West Tavaputs Environmental Impact Statement (BLM 2008d). Additional details about the modeling are in the Near-Field Air Quality Technical Support Document (Appendix H). Near-field impacts from Alternative F were not modeled. However, because emissions under Alternative F would be less than under Alternative A (which was modeled), for the purposes of this analysis, impacts under Alternative F were assumed to be equal to or less than the impacts under Alternative A.

Supplemental modeling was performed for Alternative F to evaluate operational impacts from the water evaporation facility (WEF) and well site production equipment. The additional modeling was performed for NO_X emissions from the WEF generator and well sites to evaluate potential impacts with regard to the 1-hour NO_2 NAAQS. Modeling of hazardous air pollutant (HAP) emissions from the WEF evaporation operations was also performed to evaluate potential impacts. These impacts were analyzed to also evaluate the benefits of emission-control strategies for the operation of the WEF (see Appendices H, I, and R).

4.2.1.1 DEVELOPMENT

Near-field impacts from development activities are predominantly short-term and localized to the nearby area. Pollutant emissions from development activities include the following sources:

- Well pad and road construction: equipment producing fugitive dust while moving and leveling earth
- Drilling: vehicles generating fugitive dust on access roads, and drill rig engine exhaust
- Completion: vehicles generating fugitive dust on access roads, frac pump engine and generator emissions, and completion venting emissions
- Vehicle tailpipe emissions associated with all development phases

Pollutant emissions generated from development sources are summarized in Table 4-2.

Table 4-2. Annual Well Development Emissions for Each Alternative

Pollutant	Well Development Emissions (tons/year)					
	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Criteria Pollutants and Volatile Organic Compound (VOC)						
NO_x	1,298	1,027	1,357	511	1,762	656
CO	421	332	444	167	522	433
VOC	103	81.5	113	42.6	116	103
SO_2	23.2	18.3	23.9	9.01	30.8	23
PM_{10}	4,079	3,228	4,486	1,700	3,641	4,066
$PM_{2.5}$	433	343	476	180	395	427
Hazardous Air Pollutants (HAPs)						
Benzene	0.62	0.49	0.69	0.26	0.66	0.62
Toluene	1.06	0.84	1.17	0.44	1.08	1.06
Ethylbenzene	0.04	0.03	0.04	0.02	0.04	0.04
Xylene	0.55	0.44	0.61	0.23	0.56	0.55
n-Hexane	1.21	0.96	1.33	0.50	1.21	1.21
Formaldehyde	0.44	0.35	0.48	0.18	0.14	0.56
Acetaldehyde	3.34×10^{-03}	2.64×10^{-03}	3.67×10^{-03}	1.38×10^{-03}	4.62×10^{-03}	3.34×10^{-03}
Acrolein	1.04×10^{-03}	8.23×10^{-04}	1.14×10^{-03}	4.31×10^{-04}	1.44×10^{-03}	1.04×10^{-03}
1,3-Butadiene	1.34×10^{-06}	1.06×10^{-06}	1.48×10^{-06}	5.60×10^{-07}	1.34×10^{-06}	1.34×10^{-06}
Naphthalene	0.02	0.01	0.02	0.01	0.02	0.02
Total HAPs	4.14	3.25	4.51	1.71	3.80	4.14
Greenhouse Gases (GHGs)						
CO_2	63,870	50,564	70,257	26,473	86,970	63,870
CH_4	517	409	568	215	530	517

4.2.1.1.1 DEVELOPMENT IMPACTS

Table 4-3 shows all pollutants modeled for development for the Proposed Action compared to the NAAQS. The maximum modeled concentration for NO_2 reflects an adjustment by a factor of 0.75, in accordance with standard EPA methodology (60:153 FR 40469, Aug 9, 1995) to convert from the modeled NO_x annual concentration to a NO_2 annual concentration. The modeling showed that no exceedances of NAAQS would be predicted for all development activities. The annual results demonstrate that even if these activities lasted for an entire year in the same location, the effects would be less than all applicable standards.

Table 4-3. Alternative A (Proposed Action) Near-field Development Impacts

Pollutant	Averaging Period	Ambient Air Concentration (µg/m³)[a]				
		Predicted	Background	Total	NAAQS	Percent of NAAQS (Project + Background)
NO_2[c]	Annual	5.0	8[b]	13.0	100	13%
PM_{10}	24-hour	16.40	18.0[b]	34.4	150	23%
$PM_{2.5}$	24-hour[e]	8.61	16[b]	24.6	35	70%
	Annual[f]	2.77	6[b]	8.77	15	58%
CO	1-hour Maximum	700.00	6,325[b]	7,025	40,000	18%
	8-hour Max Ave.	342.00	3,910[b]	3,910	10,000	43%
SO_2	3-hour	40.90	20[d]	60.9	1,300	5%
	24-hour	13.70	10[d]	23.7	365	6%
	Annual	1.95	5[d]	6.95	80	9%

[a] µg/m³ is micrograms of pollutant per cubic meter of air.
[b] Based on data collected at the Ouray or Redwash Monitoring Stations (see AQIA, *Greater Natural Buttes Supplement to the Draft EIS*, February 2011).
[c] Reported value is converted from modeled NO_x to NO_2 (multiplier 0.75).
[d] Source: Utah Division of Environmental Quality – Division of Air Quality (UDAQ).
[e] Concentration estimate represents the eighth maximum 24-hour PM2.5 concentrations (on average over 3 years).
[f] Annual PM modeling assumed activity takes place year-round at the same location; the actual value would be less.

4.2.1.1.1.1 One-hour NO_2 Standard

The 1-hour NO_2 NAAQS standard, effective April 12, 2010, is based on the 3-year average of the 98th percentile of the annual distribution of daily maximum 1-hour average concentrations (EPA 2010). Potential project development impacts for comparison to the new 1-hour NO_2 standard were not evaluated in this analysis.

Potential emissions from development activities would be temporary (less than 3 years) in any one location and would not otherwise contribute to NO_2 concentrations after these activities are completed. These temporary, potential emissions would not result in any significant contribution to emission levels that would result in measurable, incremental increase in NO_2 levels.

Drill rig emissions analyzed for a similar development project (*Greater Natural Buttes Supplement to the Draft EIS*; BLM 2011a) determined that under certain conditions and configurations of drilling on well pads located in close proximity to each other, short-term modeled impacts could be higher than the concentration value for the 1-hour NO_2 NAAQS.

However, compliance with the NAAQS for 1-hour NO_2 is based on the 98th percentile of the daily 1-hour maxima for each of 3 consecutive years. Because the duration of drilling scenarios is limited, the drilling activity likely would not coincide with the 98th percentile of the daily 1-hour maxima in 1 year. Also, because drill rigs move to different locations during the course of development, it is not reasonable to assume that the same level of drilling would occur for 3 consecutive years at the same location. Therefore, actual impacts that would be in violation of the 1-hour NO_2 NAAQS are not anticipated (BLM 2011a).

A short-term near-field analysis was conducted to determine how various rig spacing scenarios affect predicted exceedances of the 1-hour NO_2 NAAQS in the near-field during drilling and completion operations for the Greater Natural Buttes Supplement to the Draft EIS (BLM 2011a). This modeling exercise assumed four drill rigs at various spacing intervals of between 400 meters and 800 meters between rigs. Each rig was assumed to be driven by up to three Caterpillar G3512LE diesel-fired engines or equivalent. Separate emissions based on engines meeting Tier II and Tier IV standard were each modeled. These engines would run in tandem with only two of the engines operating at a time. Further, to complete the well, drilling would be concluded at each well by the operation of a workover rig equipped with a Caterpillar C13 engine or equivalent. This modeling predicted a near-field 1-hour NO_2 standard exceedance at distances less than 200 meters from the drill rig location for all spacing scenarios modeled (BLM 2011a).

After issuance of a ROD for this EIS, it is anticipated that the proposed facilities may be subject to permitting requirements, and as such, Gasco would be required to obtain all necessary permits under the Clean Air Act (CAA). Under this permit process, Gasco may be required to demonstrate compliance with the new one-hour NO_2 NAAQS standard and the new tribal New Source Review (NSR) permitting regulations, as well as any other applicable regulations.

Development impacts, compared to the NAAQS for each alternative, are shown in Table 4-4.

Predicted impacts for PM_{10} are slightly higher for Alternative D due to increased pipeline disturbance per pad. Predicted impacts for NO_2 and $PM_{2.5}$ are the same for Alternatives A, B, C, and D; Alternative E has the highest NO_2 and $PM_{2.5}$ impacts because directional drilling takes more time than vertical drilling. Predicted impacts from Alternative F are assumed to be less than or equal to the impacts from Alternative A due to the reduced emissions under Alternative F.

Table 4-4. Predicted Near-field Development Impacts

Pollutant	Averaging Period	Percent of NAAQS (Project + Background)					
		Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)[a]
NO_2	Annual	13%	13%	13%	13%	13%	13%
NO_2	1-hour [b]	153%	153%	153%	153%	153%	153%
PM_{10}	24-hour	23%	23%	23%	25%	23%	23%
$PM_{2.5}$	24-hour	70%	70%	70%	70%	71%	70%
	Annual	58%	58%	58%	58%	58%	58%

[a] Predicated impacts from Alternative F are assumed to be less than or equal to the impacts from Alternative A due to the reduced emissions under Alternative F.

[b] Predicted 1-hour NO_2 development impacts (drill rig engines) were based on the modeled impacts analyzed for the *Greater Natural Buttes Supplement to the Draft EIS* Air Quality Technical Support Document (Appendix G of BLM 2011a). Values represent the worst-case impact from 400-m spacing between drill rigs.

4.2.1.1.1.2 Greenhouse Gas Emissions

It can be difficult to discern whether climate change is already affecting resources globally, let alone those in the vicinity of the proposed project. In most cases, there is little information about potential or projected effects of global climate change on resources. It is important to note that projected changes are likely to occur over several decades to a century. Due to the time period over which potential impacts may occur, many of the projected changes associated with climate change may not be measurably discernible within the reasonably foreseeable future. Existing climate prediction models are global in nature; therefore, they are not at the appropriate scale to estimate potential impacts of climate change from projects in the vicinity of the project.

Although emissions from oil and gas activities may contribute to the effects of climate change to some extent, it currently is not possible to associate any of these particular actions with the creation of any specific climate-related environmental effects. The tools necessary to quantify climatic impacts presently are unavailable. As a consequence, impact assessment of specific effects of anthropogenic activities cannot be determined. Additionally, specific levels of significance have not yet been established. Therefore, climate change analysis for the purpose of this document is limited to accounting and disclosing of greenhouse gas (GHG) emissions that may contribute to climate change.

GHG emissions for Alternative A (and all the other alternatives) are presented in Appendix K and summarized below for the development phase.

GHG emissions from the development phase are shown in Table 4-5. . The majority of the GHG emissions would be emitted from the drill rig engines and well completion activities. Once the proposed wells have been constructed, GHG emissions from well development activities would cease.

Table 4-5. Greenhouse Gases – Project Development Emissions (tons/yr)

Pollutant	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
CO_2	63,870	50,564	70,257	26,476	86,970	63,870
CH_4	517	409	568	215	530	517
Total in CO_2e	74,727	59,153	82,185	30,991	98,100	74,727

Note: 1 ton of CH_4 = 21 tons CO_2e.

For comparison purposes, 100,000 tons/yr CO_2e is equivalent[1] to the following:

- Annual GHG emissions from 17,788 passsenger vehicles
- CO_2 emissions from the electricity use of 11,312 homes for one year
- CO_2 emissions from the energy use of 7,868 homes for one year

[1]*Source*: Greenhouse Gas Equivalencies Calculator (EPA 2011c).

GHG Mandatory Reporting (Subpart W)

Subpart W of the Greenhouse Gas Mandatory Reporting Rule is applicable to petroleum and natural gas systems (i.e., the project as described in the alternatives). Subpart W does not require any controls or establish any emissions standards related to GHG emissions or impacts.

Therefore, there is no requirement under the mandatory reporting rule at this time that would affect any of the proposed project alternatives, other than the possibility of monitoring, recordkeeping, and reporting of GHG emissions.

GHG Tailoring Rule

In June 2010, the EPA finalized the Greenhouse Gas Tailoring Rule. The rule outlines the time frame and the applicability criteria that determine which stationary sources and modification projects become subject to permitting requirements for GHG emissions under the Prevention of Significant Deterioration (PSD) and Title V programs of the CAA.

GHG emissions from the proposed central facilities are shown in Table 4-6 below. Based on the GHG Tailoring Rule, between June 1, 2011, and June 30, 2013, new construction of facilities that emit 100,000 tons carbon dioxide equivalents (CO_2e/yr) or more would be subject to permitting requirements. As can be seen from the table below, the individual facilities would not be anticipated to exceed the 100,000 ton/yr threshold. The Tailoring Rule does not set out new permitting thresholds beyond June 30, 2013, but EPA has indicated that additional rule making and lower permitting thresholds may be promulgated to lower the permitting thresholds to 50,000 tons CO_2e/yr beyond June 30, 2013.

Table 4-6. Greenhouse Gases – Central Facility Emissions (per facility) Tons/yr

Pollutant	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
CO_2	44,961	32,464	54,953	10,816	32,464	44,961
CH_4	491	359	607	119	359	491
Total in CO_2e	55,272	40,003	67,700	13,315	40,003	55,272

4.2.1.1.1.3 One-hour Sulfur Dioxide Standard

The 1-hour sulfur dioxide (SO_2) NAAQS standard, effective September 2010, is based on the 3-year average of the 99th percentile of the annual distribution of daily maximum 1-hour average concentrations (EPA 2010). Potential project development impacts and production impacts for comparison to the new 1-hour SO_2 standard were not evaluated for this project; however, based on the air quality analysis for a similar project (*Greater Natural Buttes Supplement to the Draft EIS*; BLM 2011a), and the relatively low amounts of development-related SO_2 emissions, project-related impacts are anticipated to remain well below the 1-hour SO_2 NAAQS.

4.2.1.2 Operations

Pollutant emissions from operations activities under all alternatives would include the following sources:

- Well production operations: three-phase separator emissions, fugitive pneumatic emissions, flashing and breathing emissions from a condensate tank
- Central production facility: central separator, compressor engines, central glycol dehydration unit emissions, flare emissions from central dehydrators and central flashing and breathing emissions from condensate tanks
- Water evaporation facility operations: produced water evaporation emissions and generator engine emissions

The near-field impact assessment considered NO_X, CO, PM_{10}, $PM_{2.5}$ and HAP emissions during the operational phase of the Gasco Uinta Basin Natural Gas Development Project after full field development. Because SO_2 emissions during this phase were negligible compared to the development phase, they were not included in the impact analysis. However, based on the air quality analysis for a similar project (*Greater Natural Buttes Supplement to the Draft EIS*; BLM 2011a), and the relatively low amounts of project-related SO_2 emissions, 1-hour SO_2 operational-related impacts are anticipated to remain well below the 1-hour SO_2 NAAQS.

Total annual project emissions for each alternative are shown in Table 4-7.

Table 4-7. Annual Operations Emissions for Each Alternative (tons/year)

Pollutant	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Criteria Pollutants and VOC						
NO_x	628	455	774	152	455	506
CO	380	268	460	91	268	380
VOC	2,421	2,033	3,117	753	2,033	1,869
SO_2	1.08	0.93	1.10	0.32	0.93	1.05
PM_{10}	2,887	2,142	3,582	698	2,142	2,888
$PM_{2.5}$	318	236	395	76.0	236	319
Hazardous Air Pollutants (HAPs)						
Benzene	20.5	16.1	25.1	5.49	16.1	17
Toluene	42.9	33.2	51.2	11.0	33	35
Ethylbenzene	2.2	1.5	2.6	0.6	1.7	2.40
Xylene	29.7	22.6	34.0	196.4	22.6	32.9
n-Hexane	33.1	24.3	41.2	8.04	24.3	30.0
Formaldehyde	11.3	8.27	14.1	2.87	8.27	5.7
Acetaldehyde	4.01	2.94	4.99	1.00	2.94	2.51
Acrolein	1.08	0.79	1.35	0.27	0.79	0.53
Methanol	786.4	757.0	988.0	192.1	757.0	422.2

Table 4-7. Annual Operations Emissions for Each Alternative (tons/year)

Pollutant	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
1,1,2,2-Tetrachloroethane	0.02	0.01	0.02	4.76×10^{-03}	0.01	0.02
1,1,2-Trichloroethane	0.02	0.01	0.02	3.79×10^{-03}	0.01	0.01
1,3-Dichloropropene	0.01	0.01	0.02	3.14×10^{-03}	0.01	0.01
1,3-Butadiene	0.13	0.09	0.16	0.03	0.09	0.01
Carbon Tetrachloride	0.02	0.01	0.02	4.37×10^{-03}	0.01	0.01
Dichlorobenzene	3.10×10^{-03}	2.27×10^{-03}	3.84×10^{-03}	7.49×10^{-04}	2.27×10^{-03}	3.58×10^{-3}
Ethylene Dibromide	0.02	0.02	0.03	0.01	0.02	0.01
Methylene Chloride	0.01	0.01	0.01	2.38×10^{-03}	0.01	0.01
Naphthalene	0.04	0.03	0.05	0.01	0.03	0.02
Vinyl Chloride	7.15×10^{-03}	5.23×10^{-03}	8.90×10^{-03}	1.77×10^{-03}	5.23×10^{-03}	4.48×10^{-3}
Benzo(b)fluoranthene[a]	9.82×10^{-05}	7.19×10^{-05}	1.22×10^{-04}	2.43×10^{-05}	7.19×10^{-05}	7.2×10^{-05}
Chrysene	3.37×10^{-04}	2.47×10^{-04}	4.20×10^{-04}	8.37×10^{-05}	2.47×10^{-04}	2.1×10^{-04}
Total HAPs	928	867.1	1,163	419.5	867.3	549
Greenhouse Gases (GHGs)						
CO_2	404,940	296,475	502,379	98,376	296,475	446,711
CH_4	6,065	4,438	7,520	1,471	4,438	5,265

[a] Pollutants are HAPs because they are polycyclic organic matter (POM).

4.2.1.2.1 Criteria Pollutant Impacts

The predicted criteria pollutant impacts are compared to applicable Utah and NAAQS standards and applicable PSD Class II increments. All comparisons with PSD Class II increments are intended only to evaluate potential significance, and do not represent a regulatory PSD increment consumption analysis. PSD increment consumption analyses are typically applied to large industrial sources during permitting, and are solely the responsibility of the State of Utah with EPA oversight. The maximum modeled concentrations for NO_2 reflects an adjustment by a factor of 0.75, in accordance with standard EPA methodology (60:153 FR 40469, Aug 9, 1995) to convert from the modeled annual NO_x concentration to a NO_2 annual concentration.

4.2.1.2.1.1 One-hour NO_2 NAAQS

The 1-hour NO_2 NAAQS, effective April 12, 2010, is based on the 3-year average of the 98th percentile of the annual distribution of daily maximum 1-hour average concentrations (EPA 2010). Potential project development impacts for comparison to the new 1-hour NO_2 standard were not evaluated in this analysis.

The NO_X emissions from the proposed generator at the WEF for Alternative F were analyzed for impacts and compliance with the 1-hour NO_2 NAAQS. Based on a common engine type for generator engines, and the RMP-required emission limits (expressed as an emission factor), the modeled results indicate that the generator at the WEF would not cause an exceedence of the 1-

hour NO_2 NAAQS. The maximum expected impacts including background are shown in Table 4-8 below.

Potential NO_2 impacts from typical production equipment were also modeled to compare impacts against the 1-hour NO_2 NAAQS. The model results for the well site equipment show that the 98th percentile of the yearly predicted NO_2 impact, in addition to the background NO_2 concentration for the local area, is below the applicable 1-hour NO_2 NAAQS. The maximum expected impacts including background values are shown in Table 4-8 below.

Table 4-8. Water Evaporation Facility (WEF) and Production Well Sites 1-hour NO_2 Modeling Analysis

Source	Meteorological Data Year	98th Percentile Predicted 1-hour NO_2 Impact (µg/m³)	Local Area Background (µg/m³)	Maximum Predicted 1-hour NO_2 Combined Background (µg/m³)	NAAQS (µg/m³)	Cumulative Impact (% of NAAQS)
WEF	2008	23.77	69	92.77	188	49.4%
Well Sites	2007	41.10	69	110.1	188	58.6%

Complete model results are presented in the supplemental air quality impact analyses (Appendices H, I, and R).

Potential emissions from operational traffic are also not expected to adversely impact 1-hour NO_2 concentrations due to the low traffic volume associated with the proposed alternatives.

Should an action alternative be carried forward into a ROD for this EIS, the proposed facilities would be subject to permitting requirements, and as such, Gasco would be required to obtain all necessary permits under the CAA. Under this permit process, Gasco may be required to demonstrate compliance with the new 1-hour NO_2 NAAQS standard and the new tribal NSR permitting regulations, as well as any other applicable regulation.

4.2.1.2.1.2 Alternative A: Proposed Action

Table 4-9 summarizes the criteria pollutant impacts resulting from Alternative A operations. All predicted concentrations remain below the NAAQS, but predicted PM_{10} concentrations exceed the PSD Class II increments. The maximum PM_{10} impacts result from truck traffic, and as PSD increments do not apply to mobile sources, PSD Class II increments are not exceeded by Alternative A.

Figure 4-1 shows contours of the predicted PM_{10} concentrations for the Proposed Action. The modeling results show that the maximum PM_{10} concentrations would occur adjacent to roads indicating the primary source of the maximum PM_{10} concentrations result from truck traffic to the WEF. For additional information see the Near-Field Air Quality Technical Support Document (Appendix H). PSD increments do not apply to mobile sources; therefore PSD Class II increments are not exceeded by the Proposed Action.

Table 4-9. Alternative A Proposed Action) Near-field Operations Criteria Pollutants Predicted Impacts

Pollutant	Averaging Period	Predicted Concentration (μg/m^3)	Percent of PSD Class II Increment	Project + Background (μg/m^3)	Percent of NAAQS (Project + Background)
NO_2[a]	Annual	14.7	58.8%	22.7[d]	23%
PM_{10}	24-hour[b]	86.2	287%	104.2[e]	69%
$PM_{2.5}$	Annual	2.04	N/A	8.04[f]	54%
	24-hour[c]	8.05	N/A	24.05[g]	69%
CO	1-hour	256	N/A	6,581[h]	16%
	8-hour	88.6	N/A	3,998[i]	40%

[a] Reported value is converted from modeled NO_x which is a surrogate for NO_2.
[b] Represents sixth-maximum concentration averaged over five years
[c] Represents eighth-maximum concentration averaged over three years
[d] with NO_2 annual background 8 μg/m^3
[e] with PM_{10} 24-hour background 18.0 μg/m^3
[f] with $PM_{2.5}$ annual background 6 μg/m^3
[g] with $PM_{2.5}$ 24-hour background 16 μg/m^3
[h] with CO 1-hour background 6,325 μg/m^3
[i] with CO 8-hour background 3,910 μg/m^3
% = percent
N/A = not applicable

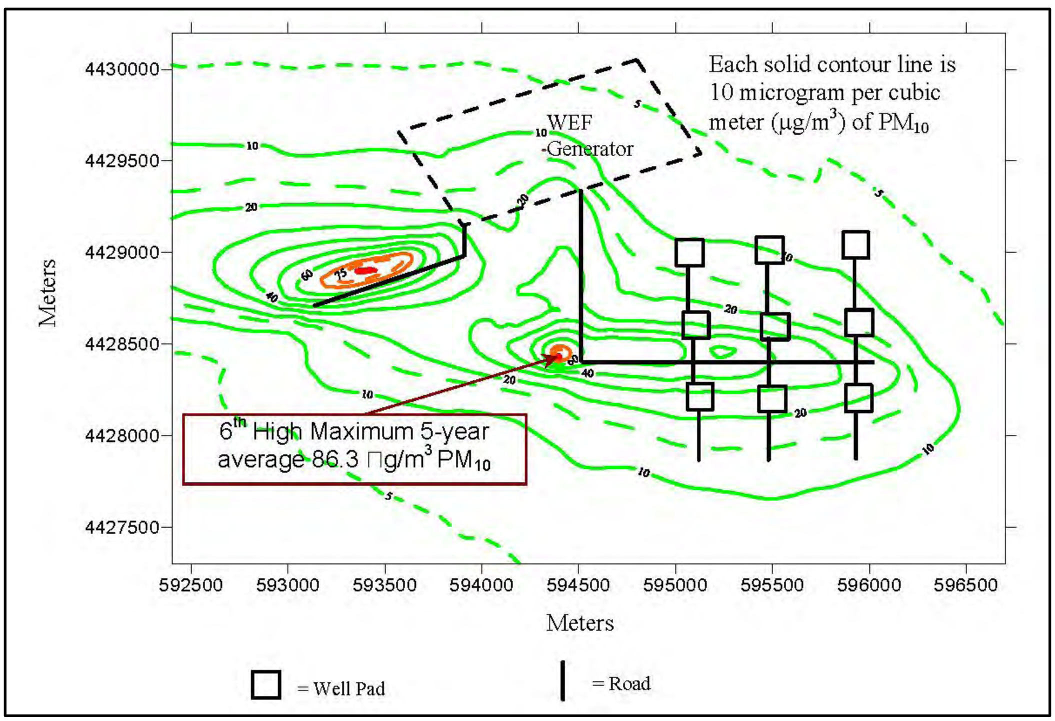

Figure 4-1. Proposed Action near-field operations five-year average of 6th high maximum predicted PM_{10} impacts.

4.2.1.2.1.3 Alternative B: Reduced Development

Table 4-10 summarizes the criteria pollutant impacts resulting from Alternative B operations. All predicted concentrations remain below the NAAQS, but predicted PM_{10} concentrations exceed the PSD Class II increments. The maximum PM_{10} impacts result from truck traffic, and as PSD increments do not apply to mobile sources, PSD Class II increments are not exceeded by Alternative B. For additional information see the Near-Field Air Quality Technical Support Document (Appendix H).

Table 4-10. Alternative B Near-field Operations Criteria Pollutants Predicted Impacts

Pollutant	Averaging Period	Predicted Concentration ($\mu g/m^3$)	Percent of PSD Class II Increment	Project + Background ($\mu g/m^3$)	Percent of NAAQS (Project + Background)
NO_2[a]	Annual	10.6	42.4%	18.6[d]	19%
PM_{10}	24-hour[b]	66.6	222%[j]	84.6[e]	56%
$PM_{2.5}$	Annual	2.26	N/A	8.3[f]	55%
	24-hour[c]	6.34	N/A	22.3[g]	64%
CO	1-hour	117	N/A	6,442[h]	16%
	8-hour	42.4	N/A	3952[i]	40%

[a] Reported value is converted from modeled NO_x which is a surrogate for NO_2.
[b] Represents sixth-maximum concentration averaged over five years
[c] Represents eighth-maximum concentration averaged over three years
[d] with NO_2 annual background 8 $\mu g/m^3$
[e] with PM_{10} 24-hour background 18 $\mu g/m^3$
[f] with $PM_{2.5}$ annual background 6 $\mu g/m^3$
[g] with $PM_{2.5}$ 24-hour background 16 $\mu g/m^3$
[h] with CO 1-hour background 6,325 $\mu g/m^3$
[i] with CO 8-hour background 3,910 $\mu g/m^3$
[j] from mobile sources (see Figure 4-1)
% = percent
N/A = not applicable

4.2.1.2.1.4 Alternative C: Full Development

Table 4-11 summarizes the criteria pollutant impacts resulting from Alternative C operations. Predicted PM_{10} concentrations exceed the NAAQS and the PSD Class II increments. The maximum PM_{10} impacts result from truck traffic, and as PSD increments do not apply to mobile sources, PSD Class II increments are not exceeded by Alternative C. For additional information see the Near-Field Air Quality Technical Support Document (Appendix H).

Table 4-11. Alternative C Near-field Operations Criteria Pollutant Predicted Impacts

Pollutant	Averaging Period	Predicted Concentration ($\mu g/m^3$)	Percent of PSD Class II Increment	Project + Background ($\mu g/m^3$)	Percent of NAAQS (Project + Background)
NO_2[a]	Annual	18.4	73.6%	26.4[d]	26%
PM_{10}	24-hour[b]	105	357%[j]	123[e]	82%
$PM_{2.5}$	Annual	2.55	N/A	8.6[f]	57%
	24-hour[c]	9.55	N/A	25.6[g]	73%
CO	1-hour	208	N/A	6,533[h]	16%
	8-hour	71.5	N/A	3,982[i]	40%

[a] Reported value is converted from modeled NO_x, which is a surrogate for NO_2
[b] Represents sixth-maximum concentration averaged over 5 years
[c] Represents eighth-maximum concentration averaged over 3 years
[d] With NO_2 annual background 8 $\mu g/m^3$
[e] With PM_{10} 24-hour background 18 $\mu g/m^3$
[f] With $PM_{2.5}$ annual background 6 $\mu g/m^3$
[g] With $PM_{2.5}$ 24-hour background 16 $\mu g/m^3$
[h] With CO 1-hour background 6,325 $\mu g/m^3$
[i] With CO 8-hour background 3,910 $\mu g/m^3$
[j] From mobile sources)
% = percent
N/A = not applicable

4.2.1.2.1.5 Alternative D: No Action

Table 4-12 summarizes the criteria pollutant impacts resulting from Alternative D operations. Predicted PM_{10} concentrations are below the NAAQS and the PSD Class II increments.

Table 4-12. Alternative D (No Action) Near-field Operations Criteria Pollutant Predicted Impacts

Pollutant	Averaging Period	Predicted Concentration ($\mu g/m^3$)	Percent of PSD Class II Increment	Project + Background ($\mu g/m^3$)	Percent of NAAQS (Project + Background)
NO_2[a]	Annual	3.56	14.2%	11.6[d]	12%
PM_{10}	24-hour[b]	20.8	69%	38.8[e]	26%
$PM_{2.5}$	Annual	0.52	N/A	6.52[f]	43%
	24-hour[c]	1.97	N/A	18.0[g]	51%
CO	1-hour	65.5	N/A	6,391[h]	16%
	8-hour	33	N/A	3,943[i]	39%

[a] Reported value is converted from modeled NO_x, which is a surrogate for NO_2
[b] Represents sixth-maximum concentration averaged over 5 years
[c] Represents eighth-maximum concentration averaged over 3 years
[d] With NO_2 annual background 8 $\mu g/m^3$
[e] With PM_{10} 24-hour background 18 $\mu g/m^3$
[f] With $PM_{2.5}$ annual background 6 $\mu g/m^3$
[g] With $PM_{2.5}$ 24-hour background 16 $\mu g/m^3$
[h] With CO 1-hour background 6,325 $\mu g/m^3$
[i] With CO 8-hour background 3,910 $\mu g/m^3$
[j] From mobile sources
% = percent
N/A = not applicable

4.2.1.2.1.6 Alternative E: Reduced Development with Directional Drilling

Alternative E impacts are the same as Alternative B because the number of wells is the same for both alternatives. Table 4-13 summarizes the criteria pollutant impacts resulting from Alternative E operations. All predicted concentrations remain below the NAAQS, but predicted PM_{10} concentrations exceed the PSD Class II increments. The maximum PM_{10} impacts result from truck traffic, and as PSD increments do not apply to mobile sources, PSD Class II increments are not exceeded by Alternative E. For additional information see the Near-Field Air Quality Technical Support Document (Appendix H).

Table 4-13. Alternative E Near-field Operations Criteria Pollutant Predicted Impacts

Pollutant	Averaging Period	Predicted Concentration (μg/m³)	Percent of PSD Class II Increment	Project + Background (μg/m³)	Percent of NAAQS (Project + Background)
NO_2[a]	Annual	10.6	42.4%	18.6[d]	19%
PM_{10}	24-hour[b]	67.2	224%[j]	85.2[e]	57%
$PM_{2.5}$	Annual	2.28	N/A	8.3[f]	55%
	24-hour[c]	6.41	N/A	22.4[g]	64%
CO	1-hour	117	N/A	6,442[h]	16%
	8-hour	61.8	N/A	3,972[i]	40%

[a] Reported value is converted from modeled NO_x, which is a surrogate for NO_2.
[b] Represents sixth-maximum concentration averaged over 5 years
[c] Represents eighth-maximum concentration averaged over 3 years
[d] With NO_2 annual background 8 μg/m³
[e] With PM_{10} 24-hour background 18 μg/m³
[f] With $PM_{2.5}$ annual background 6 μg/m³
[g] With $PM_{2.5}$ 24-hour background 16 μg/m³
[h] With CO 1-hour background 6,325 μg/m³
[i] With CO 8-hour background 3,910 μg/m³
[j] From mobile sources
% = percent
N/A = not applicable

4.2.1.2.1.7 Alternative F: Agency Preferred Alternative

Table 4-14. summarizes the criteria pollutant impacts resulting from Alternative F operations. Predicted PM_{10} concentrations are below the NAAQS and the PSD Class II increments.

Supplemental modeling was performed to assess the potential 1-hour NO_2 impacts from the generator at the WEF, and emissions from well production related equipment. As modeled, the NO_X emissions from the well site production equipment or the generator at the WEF did not exceed the 1-hour NO_2 NAAQS, (see Appendices H and I).

Table 4-14. Alternative F Near-field Operations Criteria Pollutant Predicted Impacts (modeling not performed, impacts assumed equal to or less than Alternative A)

Pollutant	Averaging Period	Predicted Concentration (µg/m³)	Percent of PSD Class II Increment	Project + Background (µg/m³)	Percent of NAAQS (Project + Background)
NO_2[a]	Annual	14.7	58.8%	22.7[d]	23%
	1-hour[k]	27.6	N/A	96.6	51%
PM_{10}	24-hour[b]	86.2	287%	104.2[e]	69%
$PM_{2.5}$	Annual	2.04	N/A	8.04[f]	54%
	24-hour[c]	8.05	N/A	24.1[g]	69%
CO	1-hour	256	N/A	6,581[h]	16%
	8-hour	88.6	N/A	3,999[i]	40%

[a] Reported value is converted from modeled NO_x, which is a surrogate for NO_2.
[b] Represents sixth-maximum concentration averaged over 5 years
[c] Represents eighth-maximum concentration averaged over 3 years
[d] With NO_2 annual background 8 µg/m³
[e] With PM_{10} 24-hour background 18 µg/m³
[f] With $PM_{2.5}$ annual background 6 µg/m³
[g] With $PM_{2.5}$ 24-hour background 16 µg/m³
[h] With CO 1-hour background 6,325 µg/m³
[i] With CO 8-hour background 3,910 µg/m³
[j] From mobile sources
% = percent
N/A = not applicable
[k] Modeling of WEF and well production equipment, 1-hour NO_2 background 69 µg/m³

4.2.1.2.2 Greenhouse Gas Impacts

Table 4-15 below shows the estimated GHG emissions for each alternative during the operational phase. Emission sources from the operational phase that generate GHGs that were included in the emission inventories include the following:

- Well site separator heaters
- Well site condensate tank flash/working/breathing emissions
- Operations vehicle tailpipe emissions
- Pneumatic device emissions
- Compressor and generator engine emissions
- Central facility dehydrator emissions
- Central facility heater emissions
- Central facility condensate tank flash/working/breathing emissions

Table 4-15. Greenhouse Gases – Overall Operational Emissions [a] (tons/year)

Pollutant	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
CO_2	404,940	296,475	502,379	98,376	296,475	446,711
CH_4	6,065	4,438	7,520	1,471	4,438	5,265
Total in CO_2e	532,305	389,673	660,299	129,267	389,673	557,276

[a] Includes emissions from the central facilities

Note: 1 ton of CH_4 = 21 tons CO_2e

The following project features (designated as Applicant-committed Environmental Protection Measures [ACEPMs] in Chapter 2) were incorporated into this analysis, which reduce and mitigate GHG emissions from the following various sources:

- Implementation of a wet gas central gathering system (reduction in methane emissions and mobile combustion emissions)
- Use of emission controls on central facility dehydrators and stock tanks (reduction in methane emissions)
- Use of low-bleed pneumatic liquid level controllers (reduction in methane emissions)
- Use of solar-powered chemical pumps (elimination of methane emissions)

Although total GHG emissions based on the life of the project cannot be forecast with confidence due to uncertainties associated with actual operational aspects, future regulations, process improvements, and other issues, a comparision of project GHG emissions on an annual basis to common activities is shown below.

For comparison purposes, 100,000 tons/yr CO_2e is equivalent[1] to the following:

- Annual GHG emissions from 17,788 passsenger vehicles
- CO^2 emissions from the electricity use of 11,312 homes for one year
- CO^2 emissions from the energy use of 7,868 homes for one year

[1] *Source*: Greenhouse Gas Equivalencies Calculator (EPA 2011c)

4.2.1.2.3 Ozone Impacts

An analysis of potential ozone impacts from Gasco project emissions and cumulative emissions was performed using the Models-3 Community Multiscale Air Quality (CMAQ) modeling system, version 4.6 publicly released October 2006. Because ozone impacts can only be evaluated when regional sources are considered, and on a regional basis, the ozone impact results are properly presented in Chapter 4, Section 4.18.3.1, Cumulative Impacts, Air Quality.

Due to the high concentrations of ozone that have been detected at monitored stations located within the Uinta Basin, the BLM will establish an ozone action plan, and conduct an updated ozone model effort as part of an adaptive management strategy/air resource management strategy. Based on the data review and criteria set forth in the ozone action plan, the BLM, in consultation with the appropriate federal, tribal and state stakeholder, will determine when to trigger implementation of the ozone action plan.

Air quality issues are being addressed on a Utah-wide basis through the Utah Air Resource Technical Advisory Group (UTAG) and the BLM's Air Resource Management Strategy (ARMS). The adaptive management strategy outlined below has been designed to develop an ozone action plan to address ozone levels in the Uinta Basin associated with oil and gas operations. The adaptive management strategy would consist of the following actions:

- Refine air quality modeling predictions
- Develop a Uinta Basin ozone action plan
- Implement a regional ozone action plan

Additional information concerning the adaptive management strategy ozone action plan is presented in Chapter 4, Section 4.18.3.1.7.2, Adaptive Management Strategy/Ozone Action Plan.

4.2.1.2.4 Hazardous Air Pollutant (HAP) Impacts

HAP emissions were evaluated against State of Utah thresholds. The State of Utah has adopted Toxic Screening Levels (TSLs) which are applied during the air permitting process to assist in the evaluation of HAPs released into the atmosphere (UDEQ-DAQ 2000). These levels are not standards that must be met, but screening thresholds which if exceeded, would suggest that additional information is needed to evaluate potential health and environmental impacts. Table 4-16 presents the predicted results in comparison to the State of Utah TSLs for averaging periods of one-hour (short-term for HAPs with predominantly acute effects) and 24-hour (for HAPs with predominantly chronic effects) for each alternative. None of the predicted pollutant levels exceed the TSLs for the State of Utah for any of the alternatives.

Table 4-16. Utah Toxic Screening Level (TSL) Impacts for Each Alternative

Pollutant and Averaging Time	TSL[b] (µg/m^3)	Percent of TSL					
		Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)[c]
Formaldehyde (1-hour)	36.8	63.3%	45.9%	78.5%	15.3%	45.9%	63.3%
Acrolein (1-hour)	22.9	9.87%	7.21%	12.3%	2.40%	7.21%	9.87%
Acetaldehyde (1-hour)	4,504	0.27%	0.20%	0.34%	0.07%	0.20%	0.27%
Benzene[a] (24-hour)	53.2	7.12%	4.62%	6.94%	1.54%	5.26%	67.7%
Toluene (24-hour)	2,512	0.42%	0.27%	0.41%	0.09%	0.27%	3.4%
Ethylbenzene (24-hour)	14,473	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%

Table 4-16. Utah Toxic Screening Level (TSL) Impacts for Each Alternative

Pollutant and Averaging Time	TSL[b] (µg/m³)	Percent of TSL					
		Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)[c]
Xylenes (24-hour)	14,473	0.07%	0.05%	0.07%	0.02%	0.05%	0.07%
n-Hexane (24-hour)	5,875	0.04%	0.04%	0.04%	0.03%	0.12%	0.04%
Methanol (24-hour)	9,282	0.01%	0.01%	0.02%	<0.01%	0.01%	56.4%

[a] Although there exists an acute TLV for benzene, the State of Utah does not apply a comparison to an acute TSL because the chronic TSL is more stringent.

[b] *Source*: Utah Division of Environmental Quality Department of Air Quality (UDEQ-DAQ) 2008

[c] Predictated impacts under Alternative F for benzene, toluene, ethylbenzene, xylenes, and methanol were modeled based on using 60% emissions control for BTEX, and no control for methanol; other HAP impacts from Alternative F were not modeled and assumed to be equal to or less than Alternative A due to the reduction in emissions. Impacts from the WEF generator engine were assumed to be similar to Alternative B based on similar engine horsepower rating.

Short-term impacts from HAP exposure were assessed by comparing one-hour average impacts to the HAP-specific acute reference exposure level (REL) and annual average impacts to the HAP-specific reference concentration (RfC, for continuous inhalation exposure). The REL is the acute concentration at or below which no adverse health effects are expected. The RfC is the average concentration (i.e., an annual average) at or below which no long-term adverse health effects are expected. Both of these guideline values are for non-cancer effects.

The predicted maximum concentrations of all HAPs are compared against the REL and RfC for each pollutant. Table 4-17, Table 4-18, Table 4-19, Table 4-20, Table 4-21, and Table 4-22 present the acute RELs and chronic RfCs for non-cancer effects for each alternative. Predicted acrolein concentrations exceed the acute REL for every alternative, but are all below the acute exposure guideline level for mild effects. Predicted concentrations for Alternatives A, B, C, and E also exceed the RfC for acrolein, but are all below the California EPA chronic REL (similar to the RfC). EPA's website documentation for the acrolein RfC indicates EPA has medium confidence in the RfC as it is based on medium quality data
(http://www.epa.gov/iris/subst/0364.htm).

4.2.1.2.4.1 Alternative A: Proposed Action

Table 4-17. Alternative A (Proposed Action) Non-carcinogenic Acute REL and RfC Impacts

HAP	REL (μg/m³)	Predicted Maximum 1-hour Impact (μg/m³)	Percent of REL	RfC[f] (μg/m³)	Predicted Maximum Annual Impact (μg/m³)	Percent of RfC
Acrolein	0.19[a]	2.26	1189%	0.02	0.04	200%
	69[b]	2.26	3.28%	0.06[g]	0.04	66.7%
	230[c]	2.26	0.98%	6.9[h]	0.73[h]	10.6%
	450[d]	2.26	0.50%	-	-	-
	2.5 [i]	2.26	90.4%	-	-	-
Formaldehyde	94[a]	23.3	24.8%	9.8	0.43	4.39%
	55 [i]	23.3	42.3%	-	-	-
Acetaldehyde	81000[b]	12.3	0.02%	9	0.23	2.56%
	470 [i]	12.3	2.6%	-	-	-
Benzene	1,300[a,e]	11.2	0.86%	30	0.26	0.87%
	160,000[d]	24.7	0.02%	-	-	-
Toluene	37,000[a]	69.9	0.19%	5,000	0.7	0.01%
Ethylbenzene	350,000[d]	3.56	<0.01%	1,000	0.04	<0.01%
Xylenes	22,000[a]	70.7	0.32%	100	0.68	0.68%
n-Hexane	390,000[d]	13.0	<0.01%	700	0.23	0.03%
Methanol	28,000[a]	3.68	0.01%	4,000	0.07	<0.01%

[a] California EPA REL for no adverse effects EPA Air Toxics Database, Table 2 (EPA 2007a)

[b] Acute Exposure Guideline Level (AEGL) for 1-hour and 8-hour exposure with mild effects for once-in-a-lifetime (rare) exposure (for exposure from spills or catastrophic releases), Table 2 (EPA 2007a)

[c] Acute Exposure Guideline Level (AEGL) for 1-hour and 8-hour exposure with moderate effects for once-in-a-lifetime (rare) exposure (for exposure from spills or catastrophic releases), Table 2 (EPA 2007a)

[d] Immediately Dangerous to Life or Health (IDLH)/10, EPA Air Toxics Database, Table 2 (EPA 2007a) because no available REL

[e] REL for benzene is based on a 6-hour exposure (OEHHA 1999), predicted concentration is a 6-hour average.

[f] EPA Air Toxics Database, Table 1 (EPA 2007a)

[g] California EPA chronic REL

[h] Minimum risk level for 1-14-day exposure for no adverse effects set by Agency for Toxic Substances and Disease Registry (ATSDR) from Table 2 (EPA 2007a) compared to 24-hour predicted concentration

[i] 1-hour Acute REL, CA OEHHA, December 2008

4.2.1.2.4.2 Alternative B: Reduced Development

Table 4-18. Alternative B Non-carcinogenic Acute REL and RfC Impacts

HAP	REL (µg/m³)	Predicted Maximum 1-hour Impact (µg/m³)	% of REL	RfC[f] (µg/m³)	Predicted Maximum Annual Impact (µg/m³)	% of RfC
Acrolein	0.19[a]	1.65	868%	0.02	0.03	150%
	69[b]	1.65	2.39%	0.06[g]	0.03	50.0%
	230[c]	1.65	0.72%	6.9[h]	0.53[h]	7.68%
	450[d]	1.65	0.37%	-	-	-
	2.5 [i]	1.65	66%	-	-	-
Formaldehyde	94[a]	16.9	18.0%	9.8	0.33	3.37%
	55 [i]	16.9	31%	-	-	-
Acetaldehyde	81000[b]	8.93	0.01%	9	0.17	1.89%
	470 [i]	8.93	2%	-	-	-
Benzene	1,300[a,e]	8.08	0.62%	30	0.16	0.53%
	160,000[d]	15.4	0.01%	-	-	-
Toluene	37,000[a]	43.5	0.12%	5,000	0.42	0.01%
Ethylbenzene	350,000[d]	2.21	<0.01%	1,000	0.02	<0.01%
Xylenes	22,000[a]	44.5	0.20%	100	0.41	0.41%
n-Hexane	390,000[d]	12.8	<0.01%	700	0.23	0.03%
Methanol	28,000[a]	2.67	0.01%	4,000	0.05	<0.01%

[a] California EPA REL for no adverse effects EPA Air Toxics Database, Table 2 (EPA 2007a)

[b] Acute Exposure Guideline Level (AEGL) for 1-hour and 8-hour exposure with mild effects for once-in-a-lifetime (rare) exposure (for exposure from spills or catastrophic releases), Table 2 (EPA 2007a)

[c] Acute Exposure Guideline Level (AEGL) for 1-hour and 8-hour exposure with moderate effects for once-in-a-lifetime (rare) exposure (for exposure from spills or catastrophic releases), Table 2 (EPA 2007a)

[d] Immediately Dangerous to Life or Health (IDLH)/10, EPA Air Toxics Database, Table 2 (EPA 2007a) because no available REL

[e] REL for benzene is based on a 6-hour exposure (OEHHA 1999), predicted concentration is a 6-hour average.

[f] EPA Air Toxics Database, Table 1 (EPA 2007a)

[g] California EPA chronic REL

[h] Minimum risk level for 1-14-day exposure for no adverse effects set by Agency for Toxic Substances and Disease Registry (ATSDR) from Table 2 (EPA 2007a) compared to 24-hour predicted concentration

[i] 1-hour Acute REL, CA OEHHA, December 2008

4.2.1.2.4.3 Alternative C: Full Development

Table 4-19. Alternative C Non-carcinogenic Acute REL and RfC Impacts

HAP	REL (µg/m^3)	Predicted Maximum 1-hour Impact (µg/m^3)	% of REL	RfC[f] (µg/m^3)	Predicted Maximum Annual Impact (µg/m^3)	% of RfC
Acrolein	0.19[a]	2.81	1479%	0.02	0.05	250%
	69[b]	2.81	4.07%	0.06[g]	0.05	83.3%
	230[c]	2.81	1.22%	6.9[h]	0.91[h]	13.2%
	450[d]	2.81	0.62%	-	-	-
	2.5[i]	2.81	112%	-	-	-
Formaldehyde	94[a]	28.9	30.7%	9.8	0.54	5.51%
	55[i]	28.9	53%	-	-	-
Acetaldehyde	81000[b]	15.2	0.02%	9	0.28	3.11%
	470[i]	15.2	3%	-	-	-
Benzene	1,300[a,e]	10.8	0.83%	30	0.23	0.77%
	160,000[d]	21.2	0.01%			
Toluene	37,000[a]	67.3	0.18%	5,000	0.67	0.01%
Ethylbenzene	350,000[d]	3.44	<0.01%	1,000	0.03	<0.01%
Xylenes	22,000[a]	68.9	0.31%	100	0.67	0.67%
n-Hexane	390,000[d]	13.0	<0.01%	700	0.24	0.03%
Methanol	28,000[a]	4.55	0.02%	4,000	0.08	<0.01%

[a] California EPA REL for no adverse effects EPA Air Toxics Database, Table 2 (EPA 2007a)

[b] Acute Exposure Guideline Level (AEGL) for 1-hour and 8-hour exposure with mild effects for once-in-a-lifetime (rare) exposure (for exposure from spills or catastrophic releases), Table 2 (EPA 2007a)

[c] Acute Exposure Guideline Level (AEGL) for 1-hour and 8-hour exposure with moderate effects for once-in-a-lifetime (rare) exposure (for exposure from spills or catastrophic releases), Table 2 (EPA 2007a)

[d] Immediately Dangerous to Life or Health (IDLH)/10, EPA Air Toxics Database, Table 2 (EPA 2007a) because no available REL

[e] REL for benzene is based on a 6-hour exposure (OEHHA 1999), predicted concentration is a 6-hour average.

[f] EPA Air Toxics Database, Table 1 (EPA 2007a)

[g] California EPA chronic REL

[h] Minimum risk level for 1-14-day exposure for no adverse effects set by Agency for Toxic Substances and Disease Registry (ATSDR) from Table 2 (EPA 2007a) compared to 24-hour predicted concentration

[i] 1-hour Acute REL, CA OEHHA, December 2008

4.2.1.2.4.4 Alternative D: No Action

Table 4-20. Alternative D (No Action) Non-carcinogenic Acute REL and RfC Impacts

HAP	REL (μg/m³)	Predicted Maximum 1-hour Impact (μg/m³)	% of REL	RfC[f] (μg/m³)	Predicted Maximum Annual Impact (μg/m³)	% of RfC
Acrolein	0.19[a]	0.55	289%	0.02	0.01	50%
	69[b]	0.55	0.80%	0.06[g]	0.01	16.7%
	230[c]	0.55	0.24%	6.9[h]	0.18[h]	2.61%
	450[d]	0.55	0.12%	-	-	-
	2.5[I]	0.55	22%	-	-	-
Formaldehyde	94[a]	5.62	5.98%	9.8	0.11	1.12%
	55[I]	5.62	10%	-	-	-
Acetaldehyde	81000[b]	2.97	<0.01%	9	0.06	0.67%
	470[I]	2.97	1%	-	-	-
Benzene	1,300[a,e]	2.69	0.21%	30	0.09	0.30%
	160,000[d]	5.15	<0.01%			
Toluene	37,000[a]	14.5	0.04%	5,000	0.16	<0.01%
Ethylbenzene	350,000[d]	0.74	<0.01%	1,000	0.01	<0.01%
Xylenes	22,000[a]	14.8	0.07%	100	0.14	0.14%
n-Hexane	390,000[d]	12.7	<0.01%	700	0.21	0.03%
Methanol	28,000[a]	0.89	<0.01%	4,000	0.02	<0.01%

[a] California EPA REL for no adverse effects EPA Air Toxics Database, Table 2 (EPA 2007a)
[b] Acute Exposure Guideline Level (AEGL) for 1-hour and 8-hour exposure with mild effects for once-in-a-lifetime (rare) exposure (for exposure from spills or catastrophic releases), Table 2 (EPA 2007a)
[c] Acute Exposure Guideline Level (AEGL) for 1-hour and 8-hour exposure with moderate effects for once-in-a-lifetime (rare) exposure (for exposure from spills or catastrophic releases), Table 2 (EPA 2007a)
[d] Immediately Dangerous to Life or Health (IDLH)/10, EPA Air Toxics Database, Table 2 (EPA 2007a) because no available REL
[e] REL for benzene is based on a 6-hour exposure (OEHHA 1999), predicted concentration is a 6-hour average.
[f] EPA Air Toxics Database, Table 1 (EPA 2007a)
[g] California EPA chronic REL
[h] Minimum risk level for 1-14-day exposure for no adverse effects set by Agency for Toxic Substances and Disease Registry (ATSDR) from Table 2 (EPA 2007a) compared to 24-hour predicted concentration
[I] 1-hour Acute REL, CA OEHHA, December 2008

4.2.1.2.4.5 Alternative E: Reduced Development with Directional Drilling

Table 4-21. Alternative E Non-carcinogenic Acute REL and RfC Impacts

HAP	REL (μg/m³)	Predicted Maximum 1-hour Impact (μg/m³)	% of REL	RfC[f] (μg/m³)	Predicted Maximum Annual Impact (μg/m³)	% of RfC
Acrolein	0.19[a]	1.65	868%	0.02	0.03	150%
	69[b]	1.65	2.39%	0.06[g]	0.03	50.0%
	230[c]	1.65	0.72%	6.9[h]	0.53[h]	7.68%
	450[d]	1.65	0.37%	-	-	-
	2.5[i]	1.65	66%	-	-	-
Formaldehyde	94[a]	16.9	18.0%	9.8	0.33	3.37%
	55[i]	16.9	31%	-	-	-
Acetaldehyde	81000[b]	8.93	0.01%	9	0.17	1.89%
	470[i]	8.93	2%	-	-	-
Benzene	1,300[a,e]	8.08	0.62%	30	0.30	1.00%
	160,000[d]	19.4	0.01%			
Toluene	37,000[a]	43.5	0.12%	5,000	0.49	0.01%
Ethylbenzene	350,000[d]	2.23	<0.01%	1,000	0.02	<0.01%
Xylenes	22,000[a]	44.5	0.20%	100	0.41	0.41%
n-Hexane	390,000[d]	49.2	0.01%	700	0.79	0.11%
Methanol	28,000[a]	2.67	0.01%	4,000	0.05	<0.01%

[a] California EPA REL for no adverse effects EPA Air Toxics Database, Table 2 (EPA 2007a)
[b] Acute Exposure Guideline Level (AEGL) for 1-hour and 8-hour exposure with mild effects for once-in-a-lifetime (rare) exposure (for exposure from spills or catastrophic releases), Table 2 (EPA 2007a)
[c] Acute Exposure Guideline Level (AEGL) for 1-hour and 8-hour exposure with moderate effects for once-in-a-lifetime (rare) exposure (for exposure from spills or catastrophic releases), Table 2 (EPA 2007a)
[d] Immediately Dangerous to Life or Health (IDLH)/10, EPA Air Toxics Database, Table 2 (EPA 2007a) because no available REL
[e] REL for benzene is based on a 6-hour exposure (OEHHA 1999), predicted concentration is a 6-hour average.
[f] EPA Air Toxics Database, Table 1 (EPA 2007a)
[g] California EPA chronic REL
[h] Minimum risk level for 1-14-day exposure for no adverse effects set by Agency for Toxic Substances and Disease Registry (ATSDR) from Table 2 (EPA 2007a) compared to 24-hour predicted concentration
[i] 1-hour Acute REL, CA OEHHA, December 2008

4.2.1.2.4.6 Alternative F: Agency Preferred Alternative

Table 4-22. Alternative F Non-carcinogenic Acute REL and RfC Impacts[J]
Note: WEF hazardous air pollutant (HAP) for Alternative F impacts presented below

HAP	REL ($\mu g/m^3$)	Predicted Maximum 1-hour Impact ($\mu g/m^3$)	% of REL	RfC[f] ($\mu g/m^3$)	Predicted Maximum Annual Impact ($\mu g/m^3$)	% of RfC
Acrolein	0.19 [a]	1.65	868%	0.02	0.03	150%
	69 [b]	1.65	2.39%	0.06 [g]	0.03	50.0%
	230 [c]	1.65	0.72%	6.9 [h]	0.53 [h]	7.68%
	450 [d]	1.65	0.37%	-	-	-
	2.5 [i]	1.65	66%	-	-	-
Formaldehyde	94 [a]	16.9[j]	18.0%	9.8	0.33[k]	3.37%
	55 [i]	16.9[j]	31%	-	-	-
Acetaldehyde	81,000 [b]	8.93	0.01%	9	0.17	1.89%
	470 [i]	8.93	2%	-	-	-
Benzene	1,300 [a, e]	65.6	5.05%	30	9.08	030.3%
	160,000 [d]	65.6	0.04%	-	-	-
Toluene	37,000 [a]	376	1.02%	5,000	21.8	0.44%
Ethylbenzene	350,000 [d]	21.28	0.01%	1,000	1.236	0.12%
Xylenes	22,000 [a]	314.4	1.43%	100	18.24	1.82%
n-Hexane	390,000 [d]	13.0	<0.01%	700	0.23	0.03%
Methanol	28,000 [a]	22,806	81.45%	4,000	01,322	33.05%

[a] California EPA REL for no adverse effects EPA Air Toxics Database (EPA 2007a, Table 2)
[b] Acute Exposure Guideline Level (AEGL) for 1-hour and 8-hour exposure with mild effects for once-in-a-lifetime (rare) exposure (for exposure from spills or catastrophic releases) (EPA 2007a, Table 2)
[c] AEGL for 1-hour and 8-hour exposure with moderate effects for once-in-a-lifetime (rare) exposure (for exposure from spills or catastrophic releases), (EPA 2007a, Table 2)
[d] Immediately Dangerous to Life or Health (IDLH)/10, EPA Air Toxics Database (EPA 2007a, Table 2) because no available REL
[e] REL for benzene is based on a 6-hour exposure (OEHHA 1999); predicted concentration is a 6-hour average.
[f] EPA Air Toxics Database (EPA 2007a, Table 1)
[g] California EPA chronic REL
[h] Minimum risk level for 1–14-day exposure for no adverse effects set by Agency for Toxic Substances and Disease Registry (ATSDR) from EPA EPA 2007a, Table 2, compared to 24-hour predicted concentration
[I] 1-hour Acute REL, CA OEHHA, December 2008
[J] Impacts for Alternative F for benzene, toluene, ethylbenzene, xylenes, and methanol were modeled based on using 60% emissions control for BTEX, and no control for methanol; other HAP impacts from Alternative F were not modeled and assumed to be equal to or less than Alternative A due to the reduction in emissions. Impacts from the WEF generator engine were assumed to be similar to Alternative B based on similar engine horsepower rating.

HAP emissions from the WEF were modeled assuming the operating scenario for Alternative F (as the Agency Preferred Alternative). HAP Eemissions were assumed to be controlled by 60%. Additional details concerning the WEF modeling can be found in the Near-Field Air Quality Technical Support Document (Appendix H).

Table 4-23. WEF-controlled Emission Scenario: HAP Impacts from the WEF

Pollutant	Maximum 1-hour Impact (μg/m^3)	REL 1-hour[a] (μg/m^3)	Maximum Annual Impact (μg/m^3)	RfC Annual[b] (μg/m^3)	Maximum 24-hour Impact (μg/m^3)	TSL 24-hour[c] (μg/m^3)
Benzene	65.6	1,300[d]	9.08	30	35.88	53
Toluene	376	37,000	21.8	5,000	86.4	2,512
Ethylbenzene	21.28	350,000	1.236	1,000	4.88	14,473
Xylene	314.4	22,000	18.24	100	72	14,473
Methanol	22,806	28,000	1,322	4,000	5,232	9,282

[a] California EPA REL for no adverse effects EPA Air Toxics Database (EPA 2007a, Table 2)
[b] EPA Air Toxics Database (EPA 2007a, Table 1)
[c] *Source*: Utah Department of Environmental Quality – Division of Air Quality (2008)
[d] Benzene REL based on a 6-hour average

4.2.1.2.5 CARCINOGENIC HAZARDOUS AIR POLLUTANT (HAP) IMPACTS

The sources of acrolein include the compressor engines and the WEF generator for all alternatives. Acrolein is a very reactive compound with a half-life in air of 1-day. Exposure to lower levels of acrolein can cause eye, nose, and throat irritation, and can lower breathing rates. Higher levels of acrolein can damage the lungs and cause death (ATSDR 2007). For perspective, the annual average ambient urban background in California is 0.15 μg/m^3 with a 95th percentile of 0.3 μg/m^3. Acrolein levels measured in smoky bars and restaurants ranged from 2.3 to 275 μg/m^3 (OEHHA 2001). A public draft is available through the OEHHA website (dated November 7, 2007) increasing the acute REL to 2.3 μg/m^3, and increasing the chronic level to 0.1 μg/m^3 (OEHHA 2007). If the draft guidelines are approved only Alternative C would exceed the acute acrolein REL. The ACGIH has set a threshold limit ceiling value of 229 μg/m^3 that should never be exceeded in a work environment (ACGIH 2007).

The risk from long-term exposure to carcinogenic HAP emissions is assessed by comparison to the generally acceptable risk range of one additional cancer per one million exposed persons (1×10^{-6}) to one additional cancer per ten thousand exposed persons (1×10^{-4}) (EPA 1993). EPA's first guidelines on carcinogen risk assessment assumed that risks exist at any dose (EPA 1986). More recent data show that there are some exceptions to this assumption however it is still the default when there is a lack of data. Therefore carcinogenic risk was assessed for the known, probable, and possible human carcinogens (possible human meaning known animal carcinogen) associated with the Proposed Action with existing unit risk factors (EPA 2007a).

Screening level risk assessment involves application of a HAP specific unit risk factor. The unit risk factor is an upper-bound estimate of the probability of one additional person contracting cancer based on continuous exposure to 1-μg/m^3 of the substance over a 70-year lifetime. Exposure adjustment factors are calculated to adjust for actual exposure times. Cancer risk is estimated for 2 exposure scenarios: the most likely exposure (MLE) that individuals will experience, and the maximally exposed individual (MEI).

The MLE was assumed to apply to people living in the Gasco Uinta Basin Natural Gas project area. For the MLE exposure adjustment factor, it is assumed that a family stays at a residence on an average of 9 years and spends 64% of the day away from the home (EPA 1997). It is further assumed that households are exposed to one-quarter of the maximum concentration the remaining 36% of the time. This results in an adjustment factor of 0.095.

An example of an MEI could be a project area pumper that visits well sites daily and lives near a well pad. For the MEI exposure adjustment factor, exposure is assumed to occur continuously (24 hours per day, 365 days per year) for the life of project (LOP), which is assumed to be 45 years. This results in an adjustment factor of 0.643.

Table 4-24 presents the unit risk factor, exposure adjustment factor, and the estimated cancer risk for the MLE and MEI exposure scenarios for carcinogenic HAPs generated by the Proposed Action. A range of unit risk factors is available for benzene. All predicted risk estimates for the Proposed Action are in the acceptable risk range.

Table 4-24. Proposed Action Carcinogenic HAP Risk

Exposure Scenario	HAP	Unit Risk Factor ($1/\mu g/m^3$)	Exposure Adjustment Factor	Modeled Annual Impact ($\mu g/m^3$)	Cancer Risk
MLE	Benzene	2.2×10^{-06} to 7.8×10^{-06}	0.095	0.26	5.4×10^{-08} to 1.9×10^{-07}
	Formaldehyde	1.3×10^{-05}	0.095	0.43	5.3×10^{-07}
	Acetaldehyde	2.2×10^{-06}	0.095	0.23	4.8×10^{-08}
	1,3-Butadiene	3×10^{-05}	0.095	7.5×10^{-03}	2.1×10^{-08}
	1,1,2,2-Tetrachloroethane	5.9×10^{-06}	0.095	1.1×10^{-03}	6.3×10^{-10}
	1,1,2-Trichloroethane	1.6×10^{-05}	0.095	8.9×10^{-04}	1.4×10^{-09}
	1,3-Dichloropropene	4×10^{-06}	0.095	7.4×10^{-04}	2.8×10^{-10}
	Carbon Tetrachloride	1.5×10^{-05}	0.095	1.0×10^{-03}	1.5×10^{-09}
	Dichlorobenzene	1.1×10^{-05}	0.095	6.0×10^{-05}	6.3×10^{-11}
	Ethylene Dibromide	6×10^{-04}	0.095	1.2×10^{-03}	7.1×10^{-08}
	Methylene Chloride	4.7×10^{-07}	0.095	5.6×10^{-04}	2.5×10^{-11}
	Naphthalene	3.4×10^{-05}	0.095	1.6×10^{-03}	5.3×10^{-09}
	Vinyl Chloride	8.8×10^{-06}	0.095	4.2×10^{-04}	3.5×10^{-11}
	Benzo(b)fluoranthene[a]	1.1×10^{-04}	0.095	4.6×10^{-06}	4.9×10^{-11}
	Chrysene[a]	1.1×10^{-05}	0.095	1.9×10^{-05}	2.0×10^{-11}
	TOTAL MLE RISK				**8.7×10^{-07}**

Table 4-24. Proposed Action Carcinogenic HAP Risk

Exposure Scenario	HAP	Unit Risk Factor (1/μg/m³)	Exposure Adjustment Factor	Modeled Annual Impact (μg/m³)	Cancer Risk
MEI	Benzene	2.2×10^{-06} to 7.8×10^{-06}	0.643	0.26	3.7×10^{-07} to 1.3×10^{-06}
	Formaldehyde	1.3×10^{-05}	0.643	0.43	3.6×10^{-06}
	Acetaldehyde	2.2×10^{-06}	0.643	0.23	3.3×10^{-07}
	1,3-Butadiene	3×10^{-05}	0.643	7.5×10^{-03}	1.4×10^{-07}
	1,1,2,2-Tetrachloroethane	5.9×10^{-06}	0.643	1.1×10^{-03}	4.2×10^{-09}
	1,1,2-Trichloroethane	1.6×10^{-05}	0.643	8.9×10^{-04}	9.2×10^{-09}
	1,3-Dichloropropene	4×10^{-06}	0.643	7.4×10^{-04}	1.9×10^{-09}
	Carbon Tetrachloride	1.5×10^{-05}	0.643	1.0×10^{-03}	9.9×10^{-09}
	Dichlorobenzene	1.1×10^{-05}	0.643	6.0×10^{-05}	4.2×10^{-10}
	Ethylene Dibromide	6×10^{-04}	0.643	1.2×10^{-03}	4.8×10^{-07}
	Methylene Chloride	4.7×10^{-07}	0.643	5.6×10^{-04}	1.7×10^{-10}
	Naphthalene	3.4×10^{-05}	0.643	1.6×10^{-03}	3.6×10^{-08}
	Vinyl Chloride	8.8×10^{-06}	0.643	4.2×10^{-04}	2.4×10^{-10}
	Benzo(b)fluoranthene[a]	1.1×10^{-04}	0.643	4.6×10^{-06}	3.3×10^{-10}
	Chrysene[a]	1.1×10^{-05}	0.643	1.9×10^{-05}	1.4×10^{-10}
	TOTAL MEI RISK				**5.9×10^{-06}**

[a] Pollutant is a HAP because it is polycyclic organic matter (POM).
MLE = most likely exposure
MEI = maximally exposed individual

There is uncertainty associated with adding cancer risk values together. The effect of exposure to multiple chemicals is not well understood. Exposure to multiple chemicals can result in increased (synergistic) effects, decreased (antagonistic) effects, or merely additive effects.

Table 4-25 and Table 4-26 present the MLE and MEI cancer risks for each alternative. The total MLE risk for Alternative C is at the low end of the acceptable risk range. All other alternatives have total MLE risk lower than the low end of the acceptable risk range. All alternatives have total MEI risk in the low end of the acceptable risk range.

Table 4-25. Carcinogenic HAP MLE Risk for Each Alternative

Hazardous Air Pollutant (HAP)	Cancer Risk					
	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)[b]
Benzene	5.4×10^{-08} to 1.9×10^{-07}	3.3×10^{-08} to 1.2×10^{-07}	5.2×10^{-08} to 1.9×10^{-07}	1.9×10^{-08} to 6.7×10^{-08}	6.3×10^{-08} to 2.2×10^{-07}	5.4×10^{-08} to 1.9×10^{-07}
Formaldehyde	5.3×10^{-07}	4.1×10^{-07}	6.7×10^{-07}	1.4×10^{-07}	4.1×10^{-07}	5.3×10^{-07}
Acetaldehyde	4.8×10^{-08}	3.6×10^{-08}	5.9×10^{-08}	1.3×10^{-08}	3.6×10^{-08}	4.8×10^{-08}
1,3-Butadiene	2.1×10^{-08}	1.5×10^{-08}	2.4×10^{-08}	6.1×10^{-09}	1.5×10^{-08}	2.1×10^{-08}
1,1,2,2-Tetrachloroethane	6.3×10^{-10}	4.5×10^{-10}	7.2×10^{-10}	1.8×10^{-10}	4.5×10^{-10}	6.3×10^{-10}
1,1,2-Trichloroethane	1.4×10^{-09}	9.7×10^{-10}	1.5×10^{-09}	3.9×10^{-10}	9.7×10^{-10}	1.4×10^{-09}
1,3-Dichloropropene	2.8×10^{-10}	2.0×10^{-10}	3.2×10^{-10}	8.0×10^{-11}	2.0×10^{-10}	2.8×10^{-10}
Carbon Tetrachloride	1.5×10^{-09}	1.0×10^{-09}	1.7×10^{-09}	4.2×10^{-10}	1.0×10^{-09}	1.5×10^{-09}
Dichlorobenzene	6.3×10^{-11}	5.2×10^{-11}	7.3×10^{-11}	1.0×10^{-11}	4.2×10^{-11}	6.3×10^{-11}
Ethylene Dibromide	7.1×10^{-08}	5.1×10^{-08}	8.1×10^{-08}	2.0×10^{-08}	5.1×10^{-08}	7.1×10^{-08}
Methylene Chloride	2.5×10^{-11}	1.8×10^{-11}	2.9×10^{-11}	7.1×10^{-12}	1.8×10^{-11}	2.5×10^{-11}
Naphthalene	5.3×10^{-09}	5.0×10^{-09}	8.2×10^{-09}	1.7×10^{-09}	5.0×10^{-09}	5.3×10^{-09}
Vinyl Chloride	3.5×10^{-11}	2.5×10^{-11}	4.0×10^{-11}	1.0×10^{-11}	2.5×10^{-11}	3.5×10^{-11}
Benzo(b)fluoranthene[a]	4.9×10^{-11}	3.5×10^{-11}	5.6×10^{-11}	1.4×10^{-11}	3.5×10^{-11}	4.9×10^{-11}
Chrysene[a]	2.0×10^{-11}	1.4×10^{-11}	2.3×10^{-11}	5.8×10^{-12}	2.3×10^{-11}	2.0×10^{-11}
TOTAL MLE RISK	$\mathbf{8.7 \times 10^{-07}}$	$\mathbf{6.4 \times 10^{-07}}$	$\mathbf{1.0 \times 10^{-06}}$	$\mathbf{2.4 \times 10^{-07}}$	$\mathbf{7.4 \times 10^{-07}}$	$\mathbf{8.7 \times 10^{-07}}$

[a] Pollutant is a HAP because it is polycyclic organic matter (POM)

[b] Predictated impacts for Alternative F for benzene, toluene, ethylbenzene, xylenes, and methanol were modeled based on using 60% emissions control for BTEX, and no control for methanol; other HAP impacts from Alternative F were not modeled and assumed to be equal to or less than Alternative A due to the reduction in emissions. Impacts from the WEF generator engine were assumed to be similar to Alternative B based on similar engine horsepower rating.

Table 4-26. Carcinogenic HAP MEI Risk for Each Alternative

Hazardous Air Pollutant (HAP)	Cancer Risk					
	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)[b]
Benzene	3.7×10^{-07} to 1.3×10^{-06}	2.3×10^{-07} to 8.0×10^{-07}	3.5×10^{-07} to 1.3×10^{-06}	1.3×10^{-07} to 4.5×10^{-07}	4.2×10^{-07} to 1.5×10^{-06}	3.7×10^{-07} to 1.3×10^{-06}
Formaldehyde	3.6×10^{-06}	2.8×10^{-06}	4.5×10^{-06}	9.2×10^{-07}	2.8×10^{-06}	3.6×10^{-06}
Acetaldehyde	3.3×10^{-07}	2.4×10^{-07}	4.0×10^{-07}	8.5×10^{-08}	2.4×10^{-07}	3.3×10^{-07}
1,3-Butadiene	1.4×10^{-07}	1.0×10^{-07}	1.6×10^{-07}	4.1×10^{-08}	1.0×10^{-07}	1.4×10^{-07}
1,1,2,2-Tetrachloroethane	4.2×10^{-09}	3.0×10^{-09}	4.9×10^{-09}	1.2×10^{-09}	3.0×10^{-09}	4.2×10^{-09}
1,1,2-Trichloroethane	9.2×10^{-09}	6.5×10^{-09}	1.0×10^{-08}	2.6×10^{-09}	6.5×10^{-09}	9.2×10^{-09}

Table 4-26. Carcinogenic HAP MEI Risk for Each Alternative

Hazardous Air Pollutant (HAP)	Cancer Risk					
	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)[b]
1,3-Dichloropropene	1.9×10^{-09}	1.4×10^{-09}	2.2×10^{-09}	5.4×10^{-10}	1.4×10^{-09}	1.9×10^{-09}
Carbon Tetrachloride	9.9×10^{-09}	7.1×10^{-09}	1.1×10^{-08}	2.8×10^{-09}	7.1×10^{-09}	9.9×10^{-09}
Dichlorobenzene	4.2×10^{-10}	3.5×10^{-10}	5.0×10^{-10}	7.1×10^{-11}	2.8×10^{-10}	4.2×10^{-10}
Ethylene Dibromide	4.8×10^{-07}	3.4×10^{-07}	5.5×10^{-07}	1.4×10^{-07}	3.4×10^{-07}	4.8×10^{-07}
Methylene Chloride	1.7×10^{-10}	1.2×10^{-10}	1.9×10^{-10}	4.8×10^{-11}	1.2×10^{-10}	1.7×10^{-10}
Naphthalene	3.6×10^{-08}	3.4×10^{-08}	5.6×10^{-08}	1.1×10^{-08}	3.4×10^{-08}	3.6×10^{-08}
Vinyl Chloride	2.4×10^{-10}	1.7×10^{-10}	2.7×10^{-10}	6.7×10^{-11}	1.7×10^{-10}	2.4×10^{-10}
Benzo(b)fluoranthene[a]	3.3×10^{-10}	2.3×10^{-10}	3.8×10^{-10}	9.4×10^{-11}	2.3×10^{-10}	3.3×10^{-10}
Chrysene[a]	1.4×10^{-10}	9.8×10^{-11}	1.6×10^{-10}	3.9×10^{-11}	2.3×10^{-11}	1.4×10^{-10}
TOTAL MEI RISK	$\mathbf{5.9 \times 10^{-06}}$	$\mathbf{4.3 \times 10^{-06}}$	$\mathbf{6.9 \times 10^{-06}}$	$\mathbf{1.7 \times 10^{-06}}$	$\mathbf{5.0 \times 10^{-06}}$	$\mathbf{5.9 \times 10^{-06}}$

[a] Pollutant is a HAP because it is polycyclic organic matter (POM)

[b] Predictated impacts for Alternative F for benzene, toluene, ethylbenzene, xylenes, and methanol were modeled based on using 60% emissions control for BTEX, and no control for methanol; other HAP impacts from Alternative F were not modeled and assumed to be equal to or less than Alternative A due to the reduction in emissions. Impacts from the WEF generator engine were assumed to be similar to Alternative B based on similar engine horsepower rating.

4.2.1.2.6 SUMMARY OF OPERATIONS IMPACTS

Implementation of the Proposed Action or Alternatives would cause increases in criteria pollutants. Potential modeled impacts for Alternative C are predicted to exceed the NAAQS for PM_{10}. Potential modeled impacts for Alternatives A, B, C, and E exceed the PSD Class II increment for PM_{10}. The distribution of concentration contours indicates that the source of the maximum PM_{10} concentrations is road traffic (see Figure 4-1). Predicted concentration contours are similar for PM_{10} and $PM_{2.5}$; the Near-Field Air Quality Technical Support Document (Appendix H) includes figures of $PM_{2.5}$ contours for each alternative showing the maximum concentrations are the result of truck traffic. Therefore none of the alternatives exceed PSD Class II increments (PSD increments do not apply to mobile sources).

Implementation of the Proposed Action or Alternatives would cause increases in HAP concentrations. The increased potential concentration would be long term, lasting the life of the project (LOP; 45 years). None of the alternatives would exceed the Utah TSLs. Potential impacts for all alternatives exceed the REL for acrolein. Alternatives A, B, C, and E are predicted to exceed the RfC for acrolein. Predicted concentrations for all alternatives are below the acute exposure guideline level for acrolein. Predicted concentrations for all alternatives are below the California EPA chronic REL (similar to the RfC) for acrolein. Minor increases in cancer risk are predicted to occur for all alternatives. However, the predicted incremental cancer risks would occur only within relatively small areas. The following tables (Table 4-27, Table 4-28, Table 4-29, Table 4-30, and Table 4-31) summarize the operational impacts for each alternative after full field development.

Table 4-27. Summary of Near-field Operation Predicted Impacts

Pollutant and Averaging Period	Averaging Period	% NAAQS (Project + Background)					
		Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)[a]
NO_2	Annual	23%	17.9%	18.8%	18.0%	18.7%	23%
PM_{10}	24-hour	69%	86.6%	112%	56.1%	87.0%	69%
$PM_{2.5}$	Annual	54%	88.7%	90.7%	76.7%	88.7%	54%
	24-hour	69%	60.9%	70.3%	48.6%	61.1%	69%
CO	1-hour	16%	3.07%	3.30%	2.94%	3.07%	16%
	8-hour	40%	11.5%	11.8%	11.4%	11.7%	40%

[a] Assumed to be equal to or less than Alternative A

Table 4-28. Summary of Near-field Operation Predicted Impacts to PSD Class II Increments

Pollutant and Averaging Period	Averaging Period	% PSD Class II Increment					
		Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)[a]
NO_2	Annual	58.8%	42.4%	73.6%	14.2%	42.4%	9.12%
PM_{10}	24-hour	287%	222%	357%	69%	222%	287%

[a] Assumed to be equal to or less than Alternative A

Table 4-29. Summary of HAP REL Operation Impacts for Each Alternative

HAP	REL (µg/m^3)	% REL					
		Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)[f]
Acrolein	0.19[a]	1,189%	868%	1,479%	289%	868%	1,189%
	69[b]	3.28%	2.39%	4.07%	0.80%	2.39%	3.28%
	230[c]	0.98%	0.72%	1.22%	0.24%	0.72%	0.98%
	450[d]	0.50%	0.37%	0.62%	0.12%	0.37%	0.50%
Formaldehyde	94[a]	24.8%	18.0%	30.7%	6.00%	18.0%	24.8%
Acetaldehyde	81000[b]	0.01%	0.01%	0.02%	<0.01%	0.01%	0.01%
Benzene	1,300[a,e]	0.86%	0.62%	0.83%	0.21%	0.62%	0.86%
	160,000[d]	0.02%	0.01%	0.01%	<0.01%	0.01%	0.02%
Toluene	37,000[a]	0.19%	0.12%	0.18%	0.04%	0.12%	0.19%
Ethylbenzene	350,000[d]	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%

Table 4-29. Summary of HAP REL Operation Impacts for Each Alternative

HAP	REL (µg/m³)	% REL					
		Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)[f]
Xylenes	22,000[a]	0.32%	0.20%	0.31%	0.07%	0.20%	0.32%
n-Hexane	390,000[d]	<0.01%	<0.01%	<0.01%	<0.01%	0.01%	≤0.01%
Methanol	28,000[a]	0.01%	0.01%	0.02%	<0.01%	0.01%	0.01%

[a] California EPA REL for no adverse effects EPA Air Toxics Database, Table 2 (EPA 2007a)

[b] Acute Exposure Guideline Level (AEGL) for 1-hour and 8-hour exposure with mild effects for once-in-a-lifetime (rare) exposure (for exposure from spills or catastrophic releases), Table 2 (EPA 2007a)

[c] Acute Exposure Guideline Level (AEGL) for 1-hour and 8-hour exposure with moderate effects for once-in-a-lifetime (rare) exposure (for exposure from spills or catastrophic releases), Table 2 (EPA 2007a)

[d] Immediately Dangerous to Life or Health (IDLH)/10, EPA Air Toxics Database, Table 2 (EPA 2007a) because no available REL

[e] REL for benzene is based on a 6-hour exposure (OEHHA 1999), predicted concentration is a 6-hour average.

[f] Predictated impacts for Alternative F for benzene, toluene, ethylbenzene, xylenes, and methanol were modeled based on using 60% emissions control for BTEX, and no control for methanol; other HAP impacts from Alternative F were not modeled and assumed to be equal to or less than Alternative A due to the reduction in emissions. Impacts from the WEF generator engine were assumed to be similar to Alternative B based on similar engine horsepower rating.

Table 4-30. Summary of HAP RfC Operation Impacts for each alternative

HAP	RfC[a] (µg/m³)	% RfC					
		Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)[d]
Acrolein	0.02	200%	150%	250%	50%	150%	200%
	0.06[b]	66.7%	50.0%	83.3%	16.7%	50.0%	66.7%
	6.9[c]	10.6%	7.68%	13.2%	2.61%	7.68%	10.6%
Formaldehyde	9.8	4.39%	3.37%	5.51%	1.12%	3.37%	4.39%
Acetaldehyde	9	2.56%	1.89%	3.11%	0.67%	1.89%	2.56%
Benzene	30	0.87%	0.53%	0.77%	0.30%	1.00%	0.87%
Toluene	5,000	0.01%	0.01%	0.01%	<0.01%	0.01%	0.01%
Ethylbenzene	1,000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Xylenes	100	0.68%	0.41%	0.67%	0.14%	0.41%	0.68%
n-Hexane	700	0.03%	0.03%	0.03%	0.03%	0.11%	0.03%
Methanol	4,000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%

[a] EPA Air Toxics Database, Table 1 (EPA 2007a)

[b] California EPA chronic REL for no adverse effects

[c] Minimum risk level for 1-14-day exposure for no adverse effects set by Agency for Toxic Substances and Disease Registry (ATSDR) from Table 2 (EPA 2007a) compared to 24-hour predicted concentration

[d] Predictated impacts for Alternative F for benzene, toluene, ethylbenzene, xylenes, and methanol were modeled based on using 60% emissions control for BTEX, and no control for methanol; other HAP impacts from Alternative F were not modeled and assumed to be equal to or less than Alternative A due to the reduction in emissions. Impacts from the WEF generator engine were assumed to be similar to Alternative B based on similar engine horsepower rating.

Table 4-31. Summary of Total Carcinogenic HAP Risk for Each Alternative

Exposure Scenario	Maximum Acceptable Risk	Cancer Risk					
		Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)[a]
MLE	1.0×10^{-4}	8.7×10^{-07}	6.4×10^{-07}	1.0×10^{-06}	2.4×10^{-07}	7.4×10^{-07}	8.7×10^{-07}
MEI	1.0×10^{-4}	5.9×10^{-06}	4.3×10^{-06}	6.9×10^{-06}	1.7×10^{-06}	5.0×10^{-06}	5.9×10^{-06}

MLE = most likely exposure
MEI = maximally exposed individual
[a] Predictated impacts for Alternative F for benzene, toluene, ethylbenzene, xylenes, and methanol were modeled based on using 60% emissions control for BTEX, and no control for methanol; other HAP impacts from Alternative F were not modeled and assumed to be equal to or less than Alternative A due to the reduction in emissions. Impacts from the WEF generator engine were assumed to be similar to Alternative B based on similar engine horsepower rating.

4.2.2 FAR-FIELD AIR QUALITY

The far-field air quality analysis focused upon project-related and cumulative impacts that could occur within areas of special concern (i.e., federally designated Class I areas) as well as sensitive Class II areas. The Far-Field Air Quality Technical Support Document (Appendix I) presents a complete description of the modeling protocol and modeling results. Table 4-32 and Table 4-33 present the areas of special concern and the associated high elevation lakes evaluated for the far-field analysis. Figure 4-2 presents a map of the Class I and II areas and analysis domain.

Table 4-32. Class I and Sensitive Class II[a] Areas

Sensitive Area	Federal Land Manager	PSD Designation
Arches NP	NPS	I
Black Canyon of the Gunnison	FS	I
Canyonlands NP	NPS	I
Capitol Reef NP	NPS	I
Flat Tops WA	FS	I
La Garita WA	FS	I
Maroon Bells-Snowmass WA	FS	I
Weminuche WA	FS	I
West Elk WA	FS	I
Colorado NM	NPS	II
Dinosaur NM	NPS	II
Flaming Gorge NRA	NPS	II
High Uintas WA	FS	II
Ouray NWR	FWS	II
Ragged WA	FS	II

[a] Class II areas included as a courtesy to federal land managers (FLMs).
NPS = National Park Service
FS = Forest Service
FWS = Fish and Wildlife Service
NP = National Park
WA = Wilderness Area
NM = National Monument
NWR = National Wildlife Refuge
NRA = National Recreation Area

Table 4-33. Sensitive Lakes

Location	Sensitive Lake
Flat Tops Wilderness Area (WA)	Ned Wilson
Flat Tops WA	Upper Ned Wilson
High Uintas WA	Dean
High Uintas WA	Pine Island
Maroon Bells WA	Moon
Raggeds WA	Deep Creek #1
West Elk WA	S. Golden

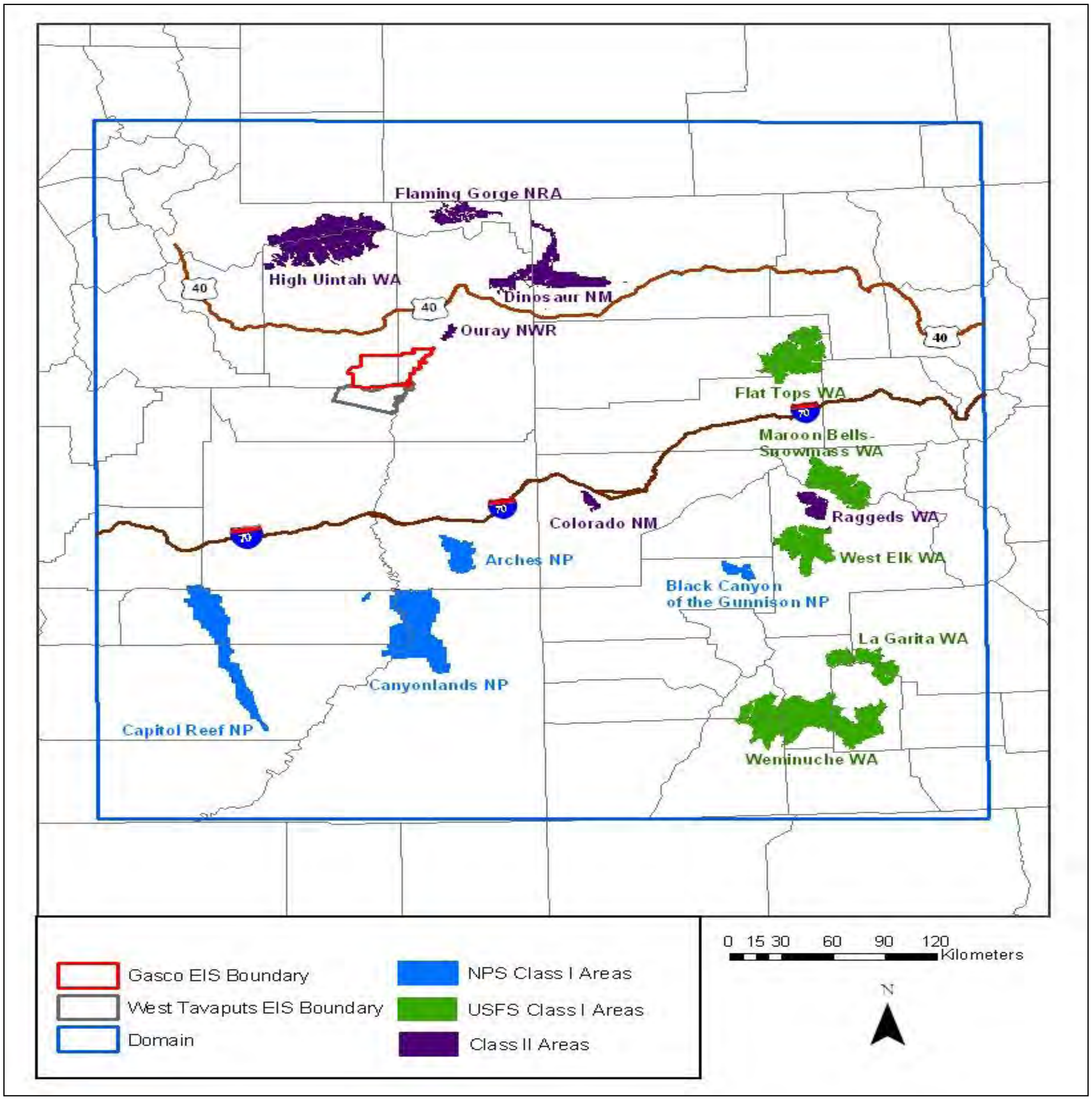

Figure 4-2. Class I and Sensitive Class II areas within analysis area.

To assess potential far-field impacts, the CALPUFF set of dispersion models were applied. The CALPUFF set of models (CALMET, CALPUFF, CALPOST, and associated utilities) were designed specifically to assess ambient air quality impacts at significant distances from the source and therefore long pollutant travel times. The predicted pollutant concentrations were compared to the NAAQS and, for informational purposes only, the PSD Class I and II increments. In addition, the predicted concentration and deposition results were processed to evaluate potential visibility and acid deposition impacts for comparison with the Federal Land Manager (FLM) Limits of Acceptable Change (LAC). The analysis was performed utilizing three years of CALMET derived meteorological data (2001–2003).

The analysis applied estimated emission rates for production activities assuming full development of each alternative plus emissions that would occur as a result of peak year well development activities. Throughout this analysis, all comparisons with PSD increments are intended only to evaluate a level of concern and do not represent a regulatory PSD increment consumption analysis. PSD increment consumption analyses are applied to large industrial sources and are solely the responsibility of the State of Utah with EPA oversight.

4.2.2.1 Ambient Air Quality Impacts

Significance criteria for potential criteria pollutant impacts include the NAAQS. Utah has adopted the NAAQS as the standard for the State.

Predicted far-field maximum pollutant concentrations that could occur as a result of the implementation of each alternative are summarized in Tables 4-27 through 4-36 and compared with Class I PSD Increments, Class II PSD Increments, and the NAAQS for years 2001–2003. As demonstrated, increases in pollutant concentrations are predicted to occur at levels below the ambient standards.

4.2.2.1.1 Class I Areas

Table 4-34, Table 4-35, Table 4-36, Table 4-37, Table 4-38, and Table 4-39 show the maximum pollutant concentrations for modeled years (2001–2003) at Class I areas under each alternative.

4.2.2.1.2 Class II Areas

Table 4-40, Table 4-41, Table 4-42, Table 4-43, Table 4-44, Table 4-45 show the maximum pollutant concentrations for modeled years (2001–2003) at Class II areas under each alternative.

Table 4-34. Alternative A (Proposed Action) Maximum Pollutant Concentrations for Modeled Years (2001–2003) at Class I Areas (micrograms per cubic meter)

Pollutant	Averaging Period	PSD Class I Increment (µg/m^3)	Arches NP	Black Canyon of the Gunnison WA	Canyonlands NP	Capitol Reef NP	Flat Tops WA	La Garita WA	Maroon Bells-Snowmass WA	Weminuche WA	West Elk WA
$PM_{2.5}$	24-hour[1]	N/A	0.101	0.06	0.14	0.098	0.07	0.021	0.051	0.018	0.051
	Annual	N/A	8.14×10^{-03}	2.46×10^{-03}	4.37×10^{-03}	1.49×10^{-03}	4.25×10^{-03}	8.39×10^{-04}	2.25×10^{-03}	7.02×10^{-04}	2.08×10^{-03}
PM_{10}	24-hour	8	0.99	0.56	1.39	0.96	0.74	0.21	0.51	0.18	0.52
NO_2	Annual	2.5	6.48×10^{-03}	1.05×10^{-03}	3.90×10^{-03}	1.13×10^{-03}	1.59×10^{-03}	1.98×10^{-04}	7.91×10^{-04}	1.80×10^{-04}	7.42×10^{-04}
SO_2	3-hour	25	0.01	2.96×10^{-03}	8.29×10^{-03}	4.25×10^{-03}	3.24×10^{-03}	1.59×10^{-03}	2.78×10^{-03}	1.60×10^{-03}	2.36×10^{-03}
	24-hour	5	2.60×10^{-03}	1.00×10^{-03}	3.05×10^{-03}	1.95×10^{-03}	9.62×10^{-04}	4.38×10^{-04}	6.51×10^{-04}	3.67×10^{-04}	6.83×10^{-04}
	Annual	2	1.74×10^{-04}	4.19×10^{-05}	9.70×10^{-05}	3.09×10^{-05}	7.80×10^{-05}	1.40×10^{-05}	3.81×10^{-05}	1.22×10^{-05}	3.42×10^{-05}

[1] Represents the modeled "eighth maximum" concentration.

Table 4-35. Alternative B Maximum Pollutant Concentrations for Modeled Years (2001–2003) at Class I Areas (micrograms per cubic meter)

Pollutant	Averaging Period	PSD Class I Increment (µg/m³)	Arches NP	Black Canyon of the Gunnison WA	Canyonlands NP	Capitol Reef NP	Flat Tops WA	La Garita WA	Maroon Bells-Snowmass WA	Weminuche WA	West Elk WA
$PM_{2.5}$	24-hour[1]	N/A	0.049	0.027	0.07	0.047	0.033	0.010	0.0238	0.008	0.0237
	Annual	N/A	3.92×10^{-03}	1.20×10^{-03}	2.12×10^{-03}	7.23×10^{-04}	2.05×10^{-03}	4.06×10^{-04}	1.09×10^{-03}	3.40×10^{-04}	1.01×10^{-03}
PM_{10}	24-hour	8	0.459	0.460	0.65	0.45	0.34	0.10	0.15	0.08	0.24
NO_2	Annual	2.5	4.87×10^{-03}	7.87×10^{-04}	2.88×10^{-03}	8.42×10^{-04}	1.23×10^{-03}	1.50×10^{-04}	6.10×10^{-04}	1.36×10^{-04}	5.74×10^{-04}
SO_2	3-hour	25	9.81×10^{-03}	2.39×10^{-03}	6.09×10^{-03}	3.31×10^{-03}	2.54×10^{-03}	1.31×10^{-03}	2.27×10^{-03}	8.95×10^{-04}	1.90×10^{-03}
	24-hour	5	2.03×10^{-03}	8.46×10^{-04}	2.41×10^{-03}	1.54×10^{-03}	7.65×10^{-04}	3.58×10^{-04}	5.23×10^{-04}	2.95×10^{-04}	5.42×10^{-04}
	Annual	2	1.36×10^{-04}	3.34×10^{-05}	7.46×10^{-05}	2.41×10^{-05}	6.28×10^{-05}	1.12×10^{-05}	3.07×10^{-05}	9.69×10^{-06}	2.73×10^{-05}

[1] Represents the modeled "eighth maximum" concentration.

N/A = not applicable

Table 4-36. Alternative C Maximum Pollutant Concentrations for Modeled Years (2001–2003) at Class I Areas (micrograms per cubic meter)

Pollutant	Averaging Period	PSD Class I Increment (µg/m³)	Arches NP	Black Canyon of the Gunnison WA	Canyonlands NP	Capitol Reef NP	Flat Tops WA	La Garita WA	Maroon Bells-Snowmass WA	Weminuche WA	West Elk WA
$PM_{2.5}$	24-hour[1]	N/A	0.117	0.06	0.16	0.113	0.08	0.025	0.059	0.021	0.059
	Annual	N/A	8.88×10^{-03}	2.86×10^{-03}	5.06×10^{-03}	1.73×10^{-03}	4.71×10^{-03}	9.73×10^{-04}	2.61×10^{-03}	8.14×10^{-04}	2.41×10^{-03}
PM_{10}	24-hour	8	1.14	0.64	1.62	1.11	0.86	0.24	0.59	0.21	0.60
NO_2	Annual	2.5	7.36×10^{-03}	1.18×10^{-03}	4.30×10^{-03}	1.26×10^{-03}	1.77×10^{-03}	2.17×10^{-04}	8.83×10^{-04}	2.02×10^{-04}	8.39×10^{-04}
SO_2	3-hour	25	0.01	3.31×10^{-03}	9.13×10^{-03}	4.65×10^{-03}	3.54×10^{-03}	1.81×10^{-03}	3.10×10^{-03}	1.80×10^{-03}	2.61×10^{-03}
	24-hour	5	2.84×10^{-03}	1.14×10^{-03}	3.43×10^{-03}	2.14×10^{-03}	1.05×10^{-03}	4.99×10^{-04}	7.13×10^{-04}	4.08×10^{-04}	7.61×10^{-04}
	Annual	2	1.92×10^{-04}	4.56×10^{-05}	1.04×10^{-04}	3.37×10^{-05}	8.49×10^{-05}	1.52×10^{-05}	4.16×10^{-05}	1.33×10^{-05}	3.74×10^{-05}

[1] Represents the modeled "eighth maximum" concentration.

N/A = not applicable

Table 4-37. Alternative D (No Action) Maximum Pollutant Concentrations for Modeled Years (2001–2003) at Class I Areas (micrograms per cubic meter)

Pollutant	Averaging Period	PSD Class I Increment (µg/m³)	Arches NP	Black Canyon of the Gunnison WA	Canyonlands NP	Capitol Reef NP	Flat Tops WA	La Garita WA	Maroon Bells-Snowmass WA	Weminuche WA	West Elk WA
$PM_{2.5}$	24-hour[1]	N/A	$1.03 \times 10\text{-}^{02}$	3.78×10^{-03}	$1.11 \times 10\text{-}_{02}$	1.09×10^{-02}	7.21×10^{-03}	1.09×10^{-03}	5.04×10^{-03}	1.74×10^{-03}	5.01×10^{-03}
	Annual	N/A	5.42×10^{-03}	1.06×10^{-03}	2.98×10^{-03}	1.54×10^{-03}	9.30×10^{-04}	7.63×10^{-04}	1.26×10^{-03}	7.50×10^{-04}	1.07×10^{-03}
PM_{10}	24-hour	8	7.65×10^{-02}	2.64×10^{-02}	$7.76 \times 10\text{-}^{02}$	7.38×10^{-02}	5.43×10^{-02}	7.12×10^{-03}	3.92×10^{-02}	1.46×10^{-02}	4.01×10^{-02}
NO_2	Annual	2.5	1.95×10^{-03}	3.23×10^{-04}	1.16×10^{-03}	3.50×10^{-04}	5.11×10^{-04}	6.09×10^{-05}	2.52×10^{-04}	5.60×10^{-05}	2.42×10^{-04}
SO_2	3-hour	25	7.56×10^{-02}	4.20×10^{-02}	1.06×10^{-01}	4.80×10^{-02}	2.77×10^{-02}	1.60×10^{-02}	2.52×10^{-02}	1.21×10^{-02}	3.07×10^{-02}
	24-hour	5	1.15×10^{-02}	6.37×10^{-03}	$1.64 \times 10\text{-}^{02}$	7.22×10^{-03}	3.86×10^{-03}	2.47×10^{-03}	3.71×10^{-03}	1.74×10^{-03}	4.37×10^{-03}
	Annual	2	7.97×10^{-04}	2.78×10^{-04}	4.81×10^{-04}	1.65×10^{-04}	4.47×10^{-04}	9.41×10^{-05}	2.55×10^{-04}	7.84×10^{-05}	2.35×10^{-04}

[1] Represents the modeled "eighth maximum" concentration.

N/A = not applicable

Table 4-38. Alternative E Maximum Pollutant Concentrations for Modeled Years (2001–2003) at Class I Areas (micrograms per cubic meter)

Pollutant	Averaging Period	PSD Class I Increment (µg/m^3)	Arches NP	Black Canyon of the Gunnison WA	Canyonlands NP	Capitol Reef NP	Flat Tops WA	La Garita WA	Maroon Bells-Snowmass WA	Weminuche WA	West Elk WA
$PM_{2.5}$	24-hour[1]	N/A	0.09	0.05	0.12	0.08	0.06	0.018	0.0425	0.015	0.0424
	Annual	N/A	6.87×10^{-03}	2.08×10^{-03}	3.69×10^{-03}	1.26×10^{-03}	3.59×10^{-03}	7.08×10^{-04}	1.90×10^{-03}	5.92×10^{-04}	1.76×10^{-03}
PM_{10}	24-hour	8	0.82	0.46	1.16	0.80	0.62	0.18	0.42	0.15	0.43
NO_2	Annual	2.5	0.008	1.25×10^{-03}	4.58×10^{-03}	1.33×10^{-03}	1.83×10^{-03}	2.31×10^{-04}	9.27×10^{-04}	2.12×10^{-04}	8.71×10^{-04}
SO_2	3-hour	25	0.018	4.03×10^{-03}	0.011	5.76×10^{-03}	4.36×10^{-03}	2.16×10^{-03}	3.74×10^{-03}	2.17×10^{-03}	3.32×10^{-03}
	24-hour	5	3.57×10^{-03}	1.31×10^{-03}	4.17×10^{-03}	2.61×10^{-03}	1.30×10^{-03}	5.92×10^{-04}	8.79×10^{-04}	4.92×10^{-04}	9.06×10^{-04}
	Annual	2	2.33×10^{-04}	5.56×10^{-05}	1.30×10^{-04}	4.16×10^{-05}	1.03×10^{-04}	1.87×10^{-05}	5.06×10^{-05}	1.64×10^{-05}	4.54×10^{-05}

[1] Represents the modeled "eighth maximum" concentration.

N/A = not applicable

Table 4-39. Alternative F[b] Maximum Pollutant Concentrations for Modeled Years (2001–2003) at Class I Areas (micrograms per cubic meter)

Pollutant	Averaging Period	PSD Class I Increment (µg/m³)	Arches NP	Black Canyon of the Gunnison WA	Canyonlands NP	Capitol Reef NP	Flat Tops WA	La Garita WA	Maroon Bells-Snowmass WA	Weminuche WA	West Elk WA
$PM_{2.5}$	24-hour[1]	$PM_{2.5}$	24-hour [1]	N/A	0.101	0.06	0.14	0.098	0.07	0.021	0.051
	Annual		Annual	N/A	8.14×10^{-03}	2.46×10^{-03}	4.37×10^{-03}	1.49×10^{-03}	4.25×10^{-03}	8.39×10^{-04}	2.25×10^{-03}
PM_{10}	24-hour	PM_{10}	24-hour	8	0.99	0.56	1.39	0.96	0.74	0.21	0.51
NO_2	Annual	NO_2	Annual	2.5	6.48×10^{-03}	1.05×10^{-03}	3.90×10^{-03}	1.13×10^{-03}	1.59×10^{-03}	1.98×10^{-04}	7.91×10^{-04}
SO_2	3-hour	SO_2	3-hour	25	0.01	2.96×10^{-03}	8.29×10^{-03}	4.25×10^{-03}	3.24×10^{-03}	1.59×10^{-03}	2.78×10^{-03}
	24-hour		24-hour	5	2.60×10^{-03}	1.00×10^{-03}	3.05×10^{-03}	1.95×10^{-03}	9.62×10^{-04}	4.38×10^{-04}	6.51×10^{-04}
	Annual		Annual	2	1.74×10^{-04}	4.19×10^{-05}	9.70×10^{-05}	3.09×10^{-05}	7.80×10^{-05}	1.40×10^{-05}	3.81×10^{-05}

[1] Represents the modeled "eighth maximum" concentration.

[b] Impacts assumed to be equal to or less than Alternative A

N/A = not applicable

Table 4-40. Alternative A (Proposed Action) Maximum Pollutant Concentrations for Modeled Years (2001–2003) at Class II Areas (micrograms per cubic meter)

Pollutant	Averaging Period	PSD Class II Increment (µg/m³)	NAAQS (µg/m³)	Dinosaur NM (II)	Colorado NM (II)	Flaming Gorge NRA (II)	Ouray NWR (II)	Ragged WA (II)	High Uintas WA (II)
$PM_{2.5}$	24-hour[1]	N/A	35	0.56	0.11	0.16	3.50	0.04	0.36
	Annual	N/A	15	0.07	6.99×10^{-03}	0.01	0.30	2.15×10^{-03}	0.01
PM_{10}	24-hour	30	150	5.89	1.07	1.73	36.7	0.44	3.77
NO_2	Annual	25	100	0.10	4.85×10^{-03}	0.01	0.66	6.70×10^{-04}	9.29×10^{-03}
SO_2	3-hour	512	1,300	0.03	6.69×10^{-03}	6.93×10^{-03}	0.27	2.13×10^{-03}	0.01
	24-hour	91	365	0.01	1.84×10^{-03}	3.29×10^{-03}	0.08	6.14×10^{-04}	6.31×10^{-03}
	Annual	20	80	1.73×10^{-03}	1.40×10^{-04}	2.96×10^{-04}	9.28×10^{-03}	3.58×10^{-05}	2.45×10^{-04}

[1] Represents the modeled "eighth maximum" concentration.

N/A = not applicable

Table 4-41. Alternative B Maximum Pollutant Concentrations for Modeled Years (2001–2003) at Class II Areas (micrograms per cubic meter)

Pollutant	Averaging Period	PSD Class II Increment (μg/m³)	NAAQS (μg/m³)	Dinosaur NM (II)	Colorado NM (II)	Flaming Gorge NRA (II)	Ouray NWR (II)	Ragged WA (II)	High Uintas WA (II)
$PM_{2.5}$	24-hour[1]	N/A	35	0.28	0.05	0.08	1.73	0.02	0.18
	Annual	N/A	15	0.04	3.39×10^{-03}	0.006	0.15	1.04×10^{-03}	0.007
PM_{10}	24-hour	N/A	15	2.75	0.50	0.81	17.1	0.20	1.76
NO_2	Annual	25	100	0.08	3.61×10^{-03}	0.009	0.55	5.19×10^{-04}	0.007
SO_2	3-hour	30	150	0.03	5.29×10^{-03}	5.62×10^{-03}	0.28	1.76×10^{-03}	0.01
	24-hour	91	365	0.01	1.45×10^{-03}	2.66×10^{-03}	0.07	4.92×10^{-04}	5.24×10^{-03}
	Annual	20	80	1.44×10^{-03}	1.11×10^{-04}	2.40×10^{-04}	8.17×10^{-03}	2.88×10^{-05}	2.02×10^{-04}

[1] Represents the modeled "eighth maximum" concentration.

N/A = not applicable

Table 4-42. Alternative C Maximum Pollutant Concentrations for Modeled Years (2001–2003) at Class II Areas (micrograms per cubic meter)

Pollutant	Averaging Period	PSD Class II Increment ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)	Dinosaur NM (II)	Colorado NM (II)	Flaming Gorge NRA (II)	Ouray NWR (II)	Ragged WA (II)	High Uintas WA (II)
$PM_{2.5}$	24-hour[1]	N/A	35	0.61	0.12	0.19	3.03	0.05	0.42
	Annual	N/A	15	0.09	8.10×10^{-03}	0.19	0.35	2.49×10^{-03}	0.02
PM_{10}	24-hour	N/A	15	6.28	1.24	2.00	38.4	0.51	4.37
NO_2	Annual	25	100	0.11	5.41×10^{-03}	0.01	0.70	7.50×10^{-04}	0.01
SO_2	3-hour	30	150	0.04	7.39×10^{-03}	8.46×10^{-03}	0.35	2.17×10^{-03}	0.02
	24-hour	91	365	0.01	2.06×10^{-03}	3.72×10^{-03}	0.09	6.71×10^{-04}	7.01×10^{-03}
	Annual	20	80	1.86×10^{-03}	1.52×10^{-04}	3.32×10^{-04}	9.33×10^{-03}	3.92×10^{-05}	2.74×10^{-04}

[1] Represents the modeled "eighth maximum" concentration.

N/A = not applicable

Table 4-43. Alternative D (No Action) Maximum Pollutant Concentrations for Modeled Years (2001–2003) at Class II Areas (micrograms per cubic meter)

Pollutant	Averaging Period	PSD Class II Increment ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)	Dinosaur NM (II)	Colorado NM (II)	Flaming Gorge NRA (II)	Ouray NWR (II)	Ragged WA (II)	High Uintas WA (II)
$PM_{2.5}$	24-hour[1]	N/A	35	0.07	0.01	0.01	0.36	4.35×10^{-03}	0.02
	Annual	N/A	15	0.01	2.84×10^{-03}	3.15×10^{-03}	0.18	8.83×10^{-04}	0.01
PM_{10}	24-hour	N/A	15	0.42	0.07	0.09	1.9	0.03	0.12
NO_2	Annual	25	100	0.03	1.48×10^{-03}	3.82×10^{-03}	0.24	2.17×10^{-04}	1.23×10^{-03}
SO_2	3-hour	30	150	0.36	0.07	0.13	2.46	0.03	0.29
	24-hour	91	365	0.06	9.97×10^{-03}	0.02	0.47	3.62×10^{-03}	0.04
	Annual	20	80	6.45×10^{-03}	8.02×10^{-04}	1.56×10^{-03}	0.04	2.44×10^{-04}	1.73×10^{-03}

[1] Represents the modeled "eighth maximum" concentration

N/A = not applicable

Table 4-44. Alternative E Maximum Pollutant Concentrations for Modeled Years (2001–2003) at Class II Areas (micrograms per cubic meter)

Pollutant	Averaging Period	PSD Class II Increment ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)	Dinosaur NM (II)	Colorado NM (II)	Flaming Gorge NRA (II)	Ouray NWR (II)	Ragged WA (II)	High Uintas WA (II)
$PM_{2.5}$	NA	N/A	35	0.48	0.09	0.14	2.94	0.04	0.31
	Annual	N/A	15	0.06	5.90×10^{-03}	0.011	0.25	1.81×10^{-03}	0.013
PM_{10}	24-hour	30	150	4.89	0.89	1.44	30.4	0.36	3.13
NO_2	Annual	25	100	0.11	5.66×10^{-03}	0.013	0.70	7.84×10^{-04}	0.011
SO_2	3-hour	512	1300	0.04	9.05×10^{-03}	9.27×10^{-03}	0.37	2.77×10^{-03}	0.02
	24-hour	91	365	0.02	2.58×10^{-03}	4.38×10^{-03}	0.10	8.34×10^{-04}	8.42×10^{-03}
	Annual	20	80	2.27×10^{-03}	1.87×10^{-04}	3.93×10^{-04}	0.01	4.78×10^{-05}	3.25×10^{-04}

[1] Represents the modeled “eighth maximum” concentration.

N/A = not applicable

Table 4-45. Alternative F[b] Maximum Pollutant Concentrations for Modeled Years (2001–2003) at Class II Areas (micrograms per cubic meter)

Pollutant	Averaging Period	PSD Class II Increment (µg/m³)	NAAQS (µg/m³)	Dinosaur NM (II)	Colorado NM (II)	Flaming Gorge NRA (II)	Ouray NWR (II)	Ragged WA (II)	High Uintas WA (II)
$PM_{2.5}$	24-hour[1]	N/A	35	0.56	0.11	0.16	3.50	0.04	0.36
	Annual	N/A	15	0.07	6.99×10^{-03}	0.01	0.30	2.15×10^{-03}	0.01
PM_{10}	24-hour	30	150	5.89	1.07	1.73	36.7	0.44	3.77
NO_2	Annual	25	100	0.10	4.85×10^{-03}	0.01	0.66	6.70×10^{-04}	9.29×10^{-03}
SO_2	3-hour	512	1300	0.03	6.69×10^{-03}	6.93×10^{-03}	0.27	2.13×10^{-03}	0.01
	24-hour	91	365	0.01	1.84×10^{-03}	3.29×10^{-03}	0.08	6.14×10^{-04}	6.31×10^{-03}
	Annual	20	80	1.73×10^{-03}	1.40×10^{-04}	2.96×10^{-04}	9.28×10^{-03}	3.58×10^{-05}	2.45×10^{-04}

[1] Represents the modeled “eighth maximum” concentration
[b] Impacts assumed to be equal to or less than Alternative A
N/A = not applicable

4.2.2.1.3 Summary of Maximum Impacts

Table 4-46 and Table 4-47 present the maximum predicted impact of the three years modeled (2001–2003) compared to the NAAQS for each alternative.

Table 4-46. Far-field Maximum Predicted Potential Impact at Class I Areas NAAQS Comparison for Each Alternative (micrograms per cubic meter)[1]

Pollutant	Averaging Time	NAAQS Standard (μg/m^3)	Impact Percentage of NAAQS					
			Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)[3]
$PM_{2.5}$	24-hour[2]	35	0.41%	0.20%	0.47%	0.03%	0.34%	0.41%
	Annual	15	0.05%	0.03%	0.06%	0.04%	0.05%	0.05%
PM_{10}	24-hour	150	0.93%	0.43%	1.08%	0.05%	0.77%	0.93%
NO_2	Annual	100	0.01%	<0.01%	0.01%	<0.01%	0.01%	0.01%
SO_2	3-hour	1300	<0.01%	<0.01%	<0.01%	0.01%	<0.01%	<0.01%
	24-hour	365	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
	Annual	80	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%

[1] All maximum impacts occur at either Arches NP or Canyonlands NP for all alternatives.
[2] Represents the modeled "eighth maximum" concentration.
[3] Impacts assumed to be equal to or less than Alternative A.

Table 4-47. Far-field Maximum Predicted Potential Impact at Class II Areas NAAQS Comparison for Each Alternative (micrograms per cubic meter)[1]

Pollutant	Averaging Time	NAAQS Standard (μg/m^3)	Impact Percentage of NAAQS					
			Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)[3]
$PM_{2.5}$	24-hour [2]	35	10.0%	4.94%	8.67%	1.03%	8.40%	10.0%
	Annual	15	1.99%	0.97%	2.31%	1.19%	1.68%	1.99%
PM_{10}	24-hour	150	24.4%	11.4%	25.6%	1.24%	20.3%	24.4%
NO_2	Annual	100	0.66%	0.55%	0.70%	0.24%	0.70%	0.66%
SO_2	3-hour	1300	0.02%	0.02%	0.03%	0.19%	0.03%	0.02%
	24-hour	365	0.02%	0.02%	0.02%	0.13%	0.03%	0.02%
	Annual	80	0.01%	0.01%	0.01%	0.05%	0.01%	0.01%

[1] All maximum impacts occur at Ouray NWR though not in the same year, except for Alternative E where the NO_2 maximum occurs at Flaming Gorge NRA
[2] Represents the modeled "eighth maximum" concentration
[3] Impacts assumed to be equal to or less than Alternative A

4.2.2.2 VISIBILITY IMPAIRMENT

The visibility assessment methodology utilized for this analysis utilized the BLM-suggested method for performing visibility impact assessments. This method involved a first level screening analysis for visibility following the recommendations in the Federal Land Managers' Air Quality Related Values Workgroup (FLAG 2000) guidance document. If the seasonal screening analysis indicated that predicted changes in visibility exceeded the 1.0 deciview (dV) LAC on more than one day per year at any mandatory federal PSD Class I area, a daily refined analysis was conducted based on hourly IMPROVE optical monitoring data measured at Canyonlands National Park for 1987 through 2004.

The screening results for each alternative are presented in Table 4-48, Table 4-49, Table 4-50, Table 4-51, Table 4-52, and Table 4-53**.** Because there were no changes in visibility that exceeded 1.0 deciview LAC on more than one day per year at any Class I area, a refined analysis was not performed for any of the alternatives.

Table 4-48. Alternative A (Proposed Action) Screening Visibility Impacts

Area of Special Concern	2001		2002		2003	
	Days Δ dV >1.0	Max Δ dV	Days Δ dV >1.0	Max Δ dV	Days Δ dV >1.0	Max Δ dV
Arches NP (I)	0	0.692	0	0.724	0	0.824
Black Canyon of the Gunnison WA (I)	0	0.255	0	0.459	0	0.28
Canyonlands NP (I)	0	0.699	1	1.055	0	0.724
Capitol Reef NP (I)	0	0.89	0	0.559	0	0.339
Flat Tops WA (I)	0	0.412	0	0.375	0	0.44
La Garita WA (I)	0	0.06	0	0.203	0	0.096
Maroon Bells-Snowmass WA (I)	0	0.183	0	0.289	0	0.283
Weminuche WA (I)	0	0.18	0	0.337	0	0.232
West Elk WA (I)	0	0.102	0	0.158	0	0.116
Dinosaur NM (II)	57	3.191	45	3.877	45	3.697
Colorado NM (II)	0	0.494	0	0.736	0	0.78
Flaming Gorge NRA (II)	0	0.863	10	1.698	2	1.175
Ouray NWR (II)	186	8.266	173	12.889	139	11.648
Ragged WA (II)	0	0.139	0	0.287	0	0.274
High Uintas WA (II)	0	0.45	13	3.198	4	1.728

Table 4-49. Alternative B Screening Visibility Impacts

Area of Special Concern	2001		2002		2003	
	Days Δ dV >1.0	Max Δ dV	Days Δ dV >1.0	Max Δ dV	Days Δ dV >1.0	Max Δ dV
Arches NP (I)	0	0.439	0	0.453	0	0.52
Black Canyon of the Gunnison WA (I)	0	0.153	0	0.295	0	0.186
Canyonlands NP (I)	0	0.437	0	0.661	0	0.47
Capitol Reef NP (I)	0	0.583	0	0.376	0	0.214
Flat Tops WA (I)	0	0.263	0	0.25	0	0.294
La Garita WA (I)	0	0.036	0	0.133	0	0.064
Maroon Bells-Snowmass WA (I)	0	0.113	0	0.191	0	0.179
Weminuche WA (I)	0	0.067	0	0.104	0	0.077
West Elk WA (I)	0	0.109	0	0.229	0	0.147
Dinosaur NM (II)	26	2.126	17	2.756	15	2.483
Colorado NM (II)	0	0.315	0	0.467	0	0.518
Flaming Gorge NRA (II)	0	0.556	2	1.171	0	0.798
Ouray NWR (II)	111	5.728	112	9.68	91	8.9
Ragged WA (II)	0	0.093	0	0.19	0	0.173
High Uintas WA (II)	0	0.286	8	2.26	2	1.252

Table 4-50. Alternative C Screening Visibility Impacts

Area of Special Concern	2001		2002		2003	
	Days Δ dV >1.0	Max Δ dV	Days Δ dV >1.0	Max Δ dV	Days Δ dV >1.0	Max Δ dV
Arches NP (I)	0	0.798	0	0.848	0	0.914
Black Canyon of the Gunnison WA (I)	0	0.299	0	0.549	0	0.332
Canyonlands NP (I)	0	0.805	1	1.249	0	0.835
Capitol Reef NP (I)	1	1.034	0	0.658	0	0.4
Flat Tops WA (I)	0	0.483	0	0.434	0	0.512
La Garita WA (I)	0	0.07	0	0.241	0	0.114
Maroon Bells-Snowmass WA (I)	0	0.215	0	0.339	0	0.33
Weminuche WA (I)	0	0.21	0	0.187	0	0.136
West Elk WA (I)	0	0.213	0	0.408	0	0.27

Table 4-50. Alternative C Screening Visibility Impacts

Area of Special Concern	2001		2002		2003	
	Days Δ dV >1.0	Max Δ dV	Days Δ dV >1.0	Max Δ dV	Days Δ dV >1.0	Max Δ dV
Dinosaur NM (II)	82	3.732	59	4.519	56	4.15
Colorado NM (II)	0	0.576	0	0.866	0	0.924
Flaming Gorge NRA (II)	1	1.01	11	1.984	3	1.368
Ouray NWR (II)	202	9.607	189	14.307	147	13.03
Ragged WA (II)	0	0.161	0	0.337	0	0.32
High Uintas WA (II)	0	0.538	17	3.724	4	2.043

Table 4-51. Alternative D (No Action) Screening Visibility Impacts

Area of Special Concern	2001		2002		2003	
	Days Δ dV >1.0	Max Δ dV	Days Δ dV >1.0	Max Δ dV	Days Δ dV >1.0	Max Δ dV
Arches NP (I)	0	0.179	0	0.202	0	0.215
Black Canyon of the Gunnison WA (I)	0	0.06	0	0.122	0	0.079
Canyonlands NP (I)	0	0.181	0	0.264	0	0.191
Capitol Reef NP (I)	0	0.244	0	0.149	0	0.091
Flat Tops WA (I)	0	0.105	0	0.101	0	0.123
La Garita WA (I)	0	0.014	0	0.055	0	0.026
Maroon Bells-Snowmass WA (I)	0	0.045	0	0.076	0	0.072
Weminuche WA (I)	0	0.029	0	0.043	0	0.032
West Elk WA (I)	0	0.043	0	0.102	0	0.059
Dinosaur NM (II)	0	0.863	1	1.235	1	1.036
Colorado NM (II)	0	0.127	0	0.196	0	0.227
Flaming Gorge NRA (II)	0	0.227	0	0.519	0	0.336
Ouray NWR (II)	34	2.707	36	4.941	31	4.377
Ragged WA (II)	0	0.038	0	0.075	0	0.07
High Uintas WA (II)	0	0.115	0	0.998	0	0.544

Table 4-52. Alternative E Screening Visibility Impacts

Area of Special Concern	2001		2002		2003	
	Days Δ dV >1.0	Max Δ dV	Days Δ dV >1.0	Max Δ dV	Days Δ dV >1.0	Max Δ dV
Arches NP (I)	0	0.716	0	0.75	0	0.849
Black Canyon of the Gunnison WA (I)	0	0.254	0	0.458	0	0.294
Canyonlands NP (I)	0	0.718	1	1.059	0	0.752
Capitol Reef NP (I)	0	0.916	0	0.552	0	0.354
Flat Tops WA (I)	0	0.42	0	0.393	0	0.459

Table 4-52. Alternative E Screening Visibility Impacts

Area of Special Concern	2001		2002		2003	
	Days Δ dV >1.0	Max Δ dV	Days Δ dV >1.0	Max Δ dV	Days Δ dV >1.0	Max Δ dV
La Garita WA (I)	0	0.06	0	0.209	0	0.101
Maroon Bells-Snowmass WA (I)	0	0.186	0	0.292	0	0.289
Weminuche WA (I)	0	0.179	0	0.342	0	0.237
West Elk WA (I)	0	0.107	0	0.163	0	0.122
Dinosaur NM (II)	53	3.133	42	3.954	42	3.635
Colorado NM (II)	0	0.505	0	0.752	0	0.813
Flaming Gorge NRA (II)	0	0.871	10	1.791	3	1.24
Ouray NWR (II)	170	3.311	162	12.56	130	11.455
Ragged WA (II)	0	0.144	0	0.291	0	0.281
High Uintas WA (II)	0	0.442	13	3.295	4	1.798

Table 4-53. Alternative F[1] Screening Visibility Impacts

Area of Special Concern	2001		2002		2003	
	Days Δ dV >1.0	Max Δ dV	Days Δ dV >1.0	Max Δ dV	Days Δ dV >1.0	Max Δ dV
Arches NP (I)	0	0.692	0	0.724	0	0.824
Black Canyon of the Gunnison WA (I)	0	0.255	0	0.459	0	0.28
Canyonlands NP (I)	0	0.699	1	1.055	0	0.724
Capitol Reef NP (I)	0	0.89	0	0.559	0	0.339
Flat Tops WA (I)	0	0.412	0	0.375	0	0.44
La Garita WA (I)	0	0.06	0	0.203	0	0.096
Maroon Bells-Snowmass WA (I)	0	0.183	0	0.289	0	0.283
Weminuche WA (I)	0	0.18	0	0.337	0	0.232
West Elk WA (I)	0	0.102	0	0.158	0	0.116
Dinosaur NM (II)	57	3.191	45	3.877	45	3.697
Colorado NM (II)	0	0.494	0	0.736	0	0.78
Flaming Gorge NRA (II)	0	0.863	10	1.698	2	1.175
Ouray NWR (II)	186	8.266	173	12.889	139	11.648
Ragged WA (II)	0	0.139	0	0.287	0	0.274
High Uintas WA (II)	0	0.45	13	3.198	4	1.728

[1] Impacts assumed to be equal to or less than Alternative A.

4.2.2.3 Terrestrial Acid Deposition

Annual terrestrial deposition impacts were predicted for dry and wet nitrogen (N) and sulfur (S) chemical species using the CALPUFF multiple-resistance routine for predicting dry deposition and the empirical scavenging coefficient approach for wet deposition. Dry and wet deposition fluxes of gaseous and particulate N and S species were processed through POSTUTIL and CALPOST to obtain total (wet + dry) N and S deposition reported as the rate of material deposited on an area (micrograms per square meter per second, µg/(m^2 sec)). Table 4-54, Table 4-55, Table 4-56, Table 4-57, Table 4-58, Table 4-59 present the maximum predicted deposition results of the three years modeled under each of the alternatives.

The annual terrestrial deposition impacts predicted for dry and wet nitrogen (N) and sulfur (S) chemical species were compared to the FLAG deposition analysis thresholds (DAT) for Class 1 areas of 0.005 kg/ha/yr (FLAG 2010). There were no predicated impacts above the N or S DAT at any Class I area for any of the Alternatives analyzed.

Table 4-54. Alternative A (Proposed Action) Far-field Maximum Predicted Potential Impacts Nitrogen and Sulfur Deposition

Area of Special Concern (Class I Areas)	Max N Dep (kg/ha/yr)	Max S Dep (kg/ha/yr)	Area of Special Concern (Class II Areas)	Max N Dep (kg/ha/yr)	Max S Dep (kg/ha/yr)
Arches NP	2.02×10^{-03}	6.44×10^{-05}	Dinosaur NM	2.03×10^{-02}	5.79×10^{-04}
Black Canyon of the Gunnison WA	9.45×10^{-04}	2.91×10^{-05}	Colorado NM	2.52×10^{-03}	8.01×10^{-05}
Canyonlands NP	1.18×10^{-03}	3.80×10^{-05}	Flaming Gorge NRA	5.17×10^{-03}	1.71×10^{-04}
Capitol Reef NP	6.19×10^{-04}	1.62×10^{-05}	Ouray NWR	7.60×10^{-02}	1.81×10^{-03}
Flat Tops WA	1.94×10^{-03}	5.94×10^{-05}	Ragged WA	7.88×10^{-04}	2.49×10^{-05}
La Garita WA	3.67×10^{-04}	1.15×10^{-05}	High Uintas WA	2.40×10^{-03}	8.12×10^{-05}
Maroon Bells-Snowmass WA	8.88×10^{-04}	2.79×10^{-05}			
Weminuche WA	3.64×10^{-04}	1.10×10^{-05}			
West Elk WA	7.91×10^{-04}	2.47×10^{-05}			

NP = National Park
WA = Wilderness Area
NM = National Monument
NWR = National Wildlife Refuge
NRA = National Recreation Area
Dep = deposition

Table 4-55. Alternative B Far-field Maximum Predicted Potential Impacts Nitrogen and Sulfur Deposition

Area of Special Concern (Class I Areas)	Max N Dep (kg/ha/yr)	Max S Dep (kg/ha/yr)	Area of Special Concern (Class II Areas)	Max N Dep (kg/ha/yr)	Max S Dep (kg/ha/yr)
Arches NP	1.45×10^{-03}	5.00×10^{-05}	Dinosaur NM	1.61×10^{-02}	4.60×10^{-04}
Black Canyon of the Gunnison WA	7.26×10^{-04}	2.22×10^{-05}	Colorado NM	1.91×10^{-03}	6.13×10^{-05}
Canyonlands NP	8.97×10^{-04}	2.86×10^{-05}	Flaming Gorge NRA	4.04×10^{-03}	1.33×10^{-04}
Capitol Reef NP	4.82×10^{-04}	1.25×10^{-05}	Ouray NWR	6.32×10^{-02}	1.53×10^{-03}
Flat Tops WA	1.51×10^{-03}	4.60×10^{-05}	Ragged WA	6.09×10^{-04}	1.91×10^{-05}
La Garita WA	2.84×10^{-04}	8.87×10^{-06}	High Uintas WA	1.86×10^{-03}	6.66×10^{-05}
Maroon Bells-Snowmass WA	6.83×10^{-04}	2.13×10^{-05}			
Weminuche WA	2.79×10^{-04}	8.46×10^{-06}			
West Elk WA	6.14×10^{-04}	1.90×10^{-05}			

NP = National Park
WA = Wilderness Area
NM = National Monument
NWR = National Wildlife Refuge
NRA = National Recreation Area

Table 4-56. Alternative C Far-field Maximum Predicted Potential Impacts Nitrogen and Sulfur Deposition

Area of Special Concern (Class I Areas)	Max N Dep (kg/ha/yr)	Max S Dep (kg/ha/yr)	Area of Special Concern (Class II Areas)	Max N Dep (kg/ha/yr)	Max S Dep (kg/ha/yr)
Arches NP	2.21×10^{-03}	1.21×10^{-04}	Dinosaur NM	2.30×10^{-02}	9.96×10^{-04}
Black Canyon of the Gunnison WA	1.09×10^{-03}	6.35×10^{-05}	Colorado NM	2.88×10^{-03}	1.50×10^{-04}
Canyonlands NP	1.34×10^{-03}	7.35×10^{-05}	Flaming Gorge NRA	6.01×10^{-03}	2.93×10^{-04}
Capitol Reef NP	7.14×10^{-04}	3.90×10^{-05}	Ouray NWR	8.25×10^{-02}	2.94×10^{-03}
Flat Tops WA	2.25×10^{-03}	1.41×10^{-04}	Ragged WA	9.20×10^{-04}	5.47×10^{-05}
La Garita WA	4.24×10^{-04}	2.59×10^{-05}	High Uintas WA	2.73×10^{-03}	1.53×10^{-04}
Maroon Bells-Snowmass WA	1.02×10^{-03}	6.30×10^{-05}			
Weminuche WA	4.21×10^{-04}	2.56×10^{-05}			
West Elk WA	9.14×10^{-04}	5.65×10^{-05}			

NP = National Park
WA = Wilderness Area
NM = National Monument
NWR = National Wildlife Refuge
NRA = National Recreation Area

Table 4-57. Alternative D (No Action) Far-field Maximum Predicted Potential Impacts Nitrogen and Sulfur Deposition

Area of Special Concern (Class I Areas)	Max N Dep (kg/ha/yr)	Max S Dep (kg/ha/yr)	Area of Special Concern (Class II Areas)	Max N Dep (kg/ha/yr)	Max S Dep (kg/ha/yr)
Arches NP	7.12×10^{-04}	2.92×10^{-05}	Dinosaur NM	7.54×10^{-03}	2.65×10^{-04}
Black Canyon of the Gunnison WA	3.53×10^{-04}	1.29×10^{-05}	Colorado NM	9.37×10^{-04}	3.59×10^{-05}
Canyonlands NP	4.22×10^{-04}	1.67×10^{-05}	Flaming Gorge NRA	1.98×10^{-03}	8.00×10^{-05}
Capitol Reef NP	2.36×10^{-04}	7.25×10^{-06}	Ouray NWR	2.88×10^{-02}	8.53×10^{-04}
Flat Tops WA	7.48×10^{-04}	2.69×10^{-05}	Ragged WA	3.05×10^{-04}	1.12×10^{-05}
La Garita WA	1.39×10^{-04}	5.16×10^{-06}	High Uintas WA	8.97×10^{-04}	3.85×10^{-05}
Maroon Bells-Snowmass WA	3.36×10^{-04}	1.25×10^{-05}			
Weminuche WA	1.41×10^{-04}	4.86×10^{-06}			
West Elk WA	2.99×10^{-04}	1.11×10^{-05}			

NP = National Park
WA = Wilderness Area
NM = National Monument
NWR = National Wildlife Refuge
NRA = National Recreation Area

Table 4-58. Alternative E Far-field Maximum Predicted Potential Impacts Nitrogen and Sulfur Deposition

Area of Special Concern Class I Areas	Max N Dep (kg/ha/yr)	Max S Dep (kg/ha/yr)	Area of Special Concern Class II Areas	Max N Dep (kg/ha/yr)	Max S Dep (kg/ha/yr)
Arches NP	8.82×10^{-04}	8.86×10^{-05}	Dinosaur NM	9.39×10^{-03}	7.53×10^{-04}
Black Canyon of the Gunnison WA	4.33×10^{-04}	3.81×10^{-05}	Colorado NM	1.15×10^{-03}	1.05×10^{-04}
Canyonlands NP	5.36×10^{-04}	5.01×10^{-05}	Flaming Gorge NRA	2.37×10^{-03}	2.23×10^{-04}
Capitol Reef NP	2.84×10^{-04}	2.10×10^{-05}	Ouray NWR	3.38×10^{-02}	2.23×10^{-03}
Flat Tops WA	8.92×10^{-04}	7.74×10^{-05}	Ragged WA	3.65×10^{-04}	3.26×10^{-05}
La Garita WA	1.69×10^{-04}	1.52×10^{-05}	High Uintas WA	1.06×10^{-03}	1.08×10^{-04}
Maroon Bells-Snowmass WA	4.06×10^{-04}	3.67×10^{-05}			
Weminuche WA	1.70×10^{-04}	1.44×10^{-05}			
West Elk WA	3.64×10^{-04}	3.22×10^{-05}			

NP = National Park
WA = Wilderness Area
NM = National Monument
NWR = National Wildlife Refuge
NRA = National Recreation Area

Table 4-59. Alternative F [1] Far-field Maximum Predicted Potential Impacts Nitrogen and Sulfur Deposition

Area of Special Concern Class I Areas	Max N Dep (kg/ha/yr)	Max S Dep (kg/ha/yr)	Area of Special Concern Class II Areas	Max N Dep (kg/ha/yr)	Max S Dep (kg/ha/yr)
Arches NP	2.02×10^{-03}	6.44×10^{-05}	Dinosaur NM	2.03×10^{-02}	5.79×10^{-04}
Black Canyon of the Gunnison WA	9.45×10^{-04}	2.91×10^{-05}	Colorado NM	2.52×10^{-03}	8.01×10^{-05}
Canyonlands NP	1.18×10^{-03}	3.80×10^{-05}	Flaming Gorge NRA	5.17×10^{-03}	1.71×10^{-04}
Capitol Reef NP	6.19×10^{-04}	1.62×10^{-05}	Ouray NWR	7.60×10^{-02}	1.81×10^{-03}
Flat Tops WA	1.94×10^{-03}	5.94×10^{-05}	Ragged WA	7.88×10^{-04}	2.49×10^{-05}
La Garita WA	3.67×10^{-04}	1.15×10^{-05}	High Uintas WA	2.40×10^{-03}	8.12×10^{-05}
Maroon Bells-Snowmass WA	8.88×10^{-04}	2.79×10^{-05}			
Weminuche WA	3.64×10^{-04}	1.10×10^{-05}			
West Elk WA	7.91×10^{-04}	2.47×10^{-05}			

NP = National Park
WA = Wilderness Area
NM = National Monument
NWR = National Wildlife Refuge
NRA = National Recreation Area\
[1]Assumed to be equal to or less than Alternative A

4.2.2.4 Aquatic Acid Deposition

Potential acid neutralization capacity (ANC) impacts were calculated by applying the screening methodology prescribed by the USFS (2000). Table 4-60, Table 4-61, Table 4-62, Table 4-63, Table 4-64, and Table 4-65 present the maximum predicted impact of the three years modeled. Predicted impacts at all lakes are less than one micro equivalent per liter (μeq/l; for extremely sensitive lakes) or a 10% change in ANC.

Table 4-60. Alternative A (Proposed Action) Far-field Maximum Predicted Potential Impacts Acid Neutralization Capacity (ANC)

Lake of Special Concern	Baseline Lake Outlet ANC (A) (µeq/l)	Annual Precipitation (P) (meters)	Watershed (W) Catchment Area (hectares)	Nitrogen (Dn) Deposition (kg/ha/yr)	Sulfur (Ds) Deposition (kg/ha/yr)	Lake Catchment Baseline ANC(o) (eq)	Nitrogen (Hn) Deposition (eq/m2/yr)	Sulfur (Hs) Deposition (eq/m2/yr)	Total (Hdep) Deposition (eq)	ANC Change (µeq/l)	Percent ANC Change
Ned Wilson	38.5	1.02	9	1.72×10^{-03}	5.24×10^{-05}	2,236	1.23×10^{-05}	3.27×10^{-07}	0.45	0.01	0.020%
Upper Ned Wilson	12.8	1.02	3	1.72×10^{-03}	5.24×10^{-05}	271	1.23×10^{-05}	3.27×10^{-07}	0.16	0.01	0.061%
Moon	51.5	1.02	251	7.70×10^{-04}	2.36×10^{-05}	$8.83 \times 10^{+04}$	5.50×10^{-06}	1.47×10^{-07}	5.92	0.11	0.007%
Deep Creek[1]	44.3	1.02	360	7.34×10^{-04}	2.32×10^{-05}	$1.09 \times 10^{+05}$	5.24×10^{-06}	1.45×10^{-07}	8.37	0.19	0.008%
South Golden	111	1.02	112	6.33×10^{-04}	2.01×10^{-05}	$8.50 \times 10^{+04}$	4.52×10^{-06}	1.26×10^{-07}	2.25	0.02	0.003%
Dean	57.3	1.02	117	1.00×10^{-03}	3.07×10^{-05}	$4.58 \times 10^{+04}$	7.15×10^{-06}	1.92×10^{-07}	3.59	0.06	0.008%
Pine Island	95.6	1.02	192	9.06×10^{-04}	2.82×10^{-05}	$1.25 \times 10^{+05}$	6.47×10^{-06}	1.76×10^{-07}	5.41	0.06	0.004%

[1] For lakes with existing ANC levels less than 25 microequivalents per liter (µeq/l), a LAC of no greater than one µeq/l is applied. For lakes with existing ANC levels greater than 25 µeq/l, the LAC is no greater than a 10% change in the background ANC.

Table 4-61. Alternative B Far-field Maximum Predicted Potential Impacts Acid Neutralization Capacity

Lake of Special Concern	Baseline Lake Outlet ANC (A) (µeq/l)	Annual Precipitation (P) (meters)	Watershed (W) Catchment Area (hectares)	Nitrogen (Dn) Deposition (kg/ha/yr)	Sulfur (Ds) Deposition (kg/ha/yr)	Lake Catchment Baseline ANC(o) (eq)	Nitrogen (Hn) Deposition (eq/m2/yr)	Sulfur (Hs) Deposition (eq/m2/yr)	Total (Hdep) Deposition (eq)	ANC Change (µeq/l)	Percent ANC Change
Ned Wilson	38.5	1.02	9	1.33×10^{-03}	4.04×10^{-05}	2,236	9.54×10^{-06}	2.52×10^{-07}	0.35	0.01	0.015%
Upper Ned Wilson	12.8	1.02	3	1.33×10^{-03}	4.04×10^{-05}	271	9.54×10^{-06}	2.52×10^{-07}	0.13	0.01	0.047%
Moon	51.5	1.02	251	5.96×10^{-04}	1.81×10^{-05}	$8.83 \times 10^{+04}$	4.26×10^{-06}	1.13×10^{-07}	4.54	0.09	0.005%
Deep Creek[1]	44.3	1.02	360	5.66×10^{-04}	1.79×10^{-05}	$1.09 \times 10^{+05}$	4.04×10^{-06}	1.12×10^{-07}	6.44	0.15	0.006%
South Golden	111	1.02	112	4.91×10^{-04}	1.55×10^{-05}	$8.50 \times 10^{+04}$	3.51×10^{-06}	9.69×10^{-08}	1.74	0.02	0.002%
Dean	57.3	1.02	117	7.98×10^{-04}	2.42×10^{-05}	$4.58 \times 10^{+04}$	5.70×10^{-06}	1.51×10^{-07}	2.84	0.05	0.006%
Pine Island	95.6	1.02	192	7.26×10^{-04}	2.23×10^{-05}	$1.25 \times 10^{+05}$	5.19×10^{-06}	1.40×10^{-07}	4.29	0.04	0.003%

[1] For lakes with existing ANC levels less than 25 microequivalents per liter (µeq/l), a LAC of no greater than one µeq/l is applied. For lakes with existing ANC levels greater than 25 µeq/l, the LAC is no greater than a 10% change in the background ANC.

Table 4-62. Alternative C Far-field Maximum Predicted Potential Impacts Acid Neutralization Capacity

Lake of Special Concern	Baseline Lake Outlet ANC (A) (µeq/l)	Annual Precipitation (P) (meters)	Watershed (W) Catchment Area (hectares)	Nitrogen (Dn) Deposition (kg/ha/yr)	Sulfur (Ds) Deposition (kg/ha/yr)	Lake Catchment Baseline ANC(o) (eq)	Nitrogen (Hn) Deposition (eq/m2/yr)	Sulfur (Hs) Deposition (eq/m2/yr)	Total (Hdep) Deposition (eq)	ANC Change (µeq/l)	Percent ANC Change
Ned Wilson	38.5	1.02	9	1.99×10^{-03}	1.25×10^{-04}	2,236	1.42×10^{-05}	7.82×10^{-07}	1.07	0.03	0.048%
Upper Ned Wilson	12.8	1.02	3	1.99×10^{-03}	1.25×10^{-04}	271	1.42×10^{-05}	7.82×10^{-07}	0.39	0.03	0.144%
Moon	51.5	1.02	251	8.90×10^{-04}	5.47×10^{-05}	$8.83 \times 10^{+04}$	6.36×10^{-06}	3.42×10^{-07}	13.70	0.27	0.016%
Deep Creek[1]	44.3	1.02	360	8.57×10^{-04}	5.07×10^{-05}	$1.09 \times 10^{+05}$	6.12×10^{-06}	3.17×10^{-07}	18.20	0.41	0.017%
South Golden	111	1.02	112	7.29×10^{-04}	4.44×10^{-05}	$8.50 \times 10^{+04}$	5.21×10^{-06}	2.77×10^{-07}	4.97	0.04	0.006%
Dean	57.3	1.02	117	1.15×10^{-03}	6.51×10^{-05}	$4.58 \times 10^{+04}$	8.21×10^{-06}	4.07×10^{-07}	7.62	0.13	0.017%
Pine Island	95.6	1.02	192	1.05×10^{-03}	5.98×10^{-05}	$1.25 \times 10^{+05}$	7.50×10^{-06}	3.74×10^{-07}	11.50	0.12	0.009%

[1] For lakes with existing ANC levels less than 25 microequivalents per liter (µeq/l), a LAC of no greater than one µeq/l is applied. For lakes with existing ANC levels greater than 25 µeq/l, the LAC is no greater than a 10% change in the background ANC.

Table 4-63. Alternative D (No Action) Far-field Maximum Predicted Potential Impacts Acid Neutralization Capacity

Lake of Special Concern	Baseline Lake Outlet ANC (A) (µeq/l)	Annual Precipitation (P) (meters)	Watershed (W) Catchment Area (hectares)	Nitrogen (Dn) Deposition (kg/ha/yr)	Sulfur (Ds) Deposition (kg/ha/yr)	Lake Catchment Baseline ANC(o) (eq)	Nitrogen (Hn) Deposition (eq/m2/yr)	Sulfur (Hs) Deposition (eq/m2/yr)	Total (Hdep) Deposition (eq)	ANC Change (µeq/l)	Percent ANC Change
Ned Wilson	38.5	1.02	9	6.63×10^{-04}	2.36×10^{-05}	2,236	4.73×10^{-06}	1.48×10^{-07}	0.20	0.01	0.009%
Upper Ned Wilson	12.8	1.02	3	6.63×10^{-04}	2.36×10^{-05}	271	4.73×10^{-06}	1.48×10^{-07}	0.07	0.01	0.027%
Moon	51.5	1.02	251	2.93×10^{-04}	1.06×10^{-05}	$8.83 \times 10^{+04}$	2.09×10^{-06}	6.64×10^{-08}	2.67	0.05	0.003%
Deep Creek[1]	44.3	1.02	360	2.85×10^{-04}	1.04×10^{-05}	$1.09 \times 10^{+05}$	2.03×10^{-06}	6.51×10^{-08}	3.75	0.08	0.003%
South Golden	111	1.02	112	2.39×10^{-04}	9.02×10^{-06}	$8.50 \times 10^{+04}$	1.70×10^{-06}	5.64×10^{-08}	1.01	0.01	0.001%
Dean	57.3	1.02	117	3.80×10^{-04}	1.37×10^{-05}	$4.58 \times 10^{+04}$	2.72×10^{-06}	8.57×10^{-08}	1.61	0.03	0.004%
Pine Island	95.6	1.02	192	3.46×10^{-04}	1.27×10^{-05}	$1.25 \times 10^{+05}$	2.47×10^{-06}	7.96×10^{-08}	2.45	0.03	0.002%

[1] For lakes with existing ANC levels less than 25 microequivalents per liter (µeq/l), a LAC of no greater than one µeq/l is applied. For lakes with existing ANC levels greater than 25 µeq/l, the LAC is no greater than a 10% change in the background ANC.

Table 4-64. Alternative E Far-field Maximum Predicted Potential Impacts Acid Neutralization Capacity

Lake of Special Concern	Baseline Lake Outlet ANC (A) (μeq/l)	Annual Precipitation (P) (meters)	Watershed (W) Catchment Area (hectares)	Nitrogen (Dn) Deposition (kg/ha/yr)	Sulfur (Ds) Deposition (kg/ha/yr)	Lake Catchment Baseline ANC(o) (eq)	Nitrogen (Hn) Deposition (eq/m2/yr)	Sulfur (Hs) Deposition (eq/m2/yr)	Total (Hdep) Deposition (eq)	ANC Change (μeq/l)	Percent ANC Change
Ned Wilson	38.5	1.02	9	1.27×10^{-03}	6.82×10^{-05}	2,236	9.09×10^{-06}	4.26×10^{-07}	0.58	0.02	0.026%
Upper Ned Wilson	12.8	1.02	3	1.27×10^{-03}	6.82×10^{-05}	271	9.09×10^{-06}	4.26×10^{-07}	0.21	0.02	0.078%
Moon	51.5	1.02	251	7.57×10^{-04}	3.10×10^{-05}	$8.83 \times 10^{+04}$	5.40×10^{-06}	1.94×10^{-07}	7.79	0.15	0.009%
Deep Creek[1]	44.3	1.02	360	7.21×10^{-04}	2.97×10^{-05}	$1.09 \times 10^{+05}$	5.15×10^{-06}	1.86×10^{-07}	10.70	0.24	0.010%
South Golden	111	1.02	112	6.33×10^{-04}	2.48×10^{-05}	$8.50 \times 10^{+04}$	4.52×10^{-06}	1.55×10^{-07}	2.78	0.03	0.003%
Dean	57.3	1.02	117	7.71×10^{-04}	3.99×10^{-05}	$4.58 \times 10^{+04}$	5.51×10^{-06}	2.50×10^{-07}	4.67	0.08	0.010%
Pine Island	95.6	1.02	192	7.54×10^{-04}	3.69×10^{-05}	$1.25 \times 10^{+05}$	5.39×10^{-06}	2.31×10^{-07}	7.08	0.07	0.006%

[1] For lakes with existing ANC levels less than 25 microequivalents per liter (μeq/l), a LAC of no greater than one μeq/l is applied. For lakes with existing ANC levels greater than 25 μeq/l, the LAC is no greater than a 10% change in the background ANC.

Table 4-65. Alternative F [2] Far-field Maximum Predicted Potential Impacts Acid Neutralization Capacity

Lake of Special Concern	Baseline Lake Outlet ANC (A) (µeq/l)	Annual Precipitation (P) (meters)	Watershed (W) Catchment Area (hectares)	Nitrogen (Dn) Deposition (kg/ha/yr)	Sulfur (Ds) Deposition (kg/ha/yr)	Lake Catchment Baseline ANC(o) (eq)	Nitrogen (Hn) Deposition (eq/m2/yr)	Sulfur (Hs) Deposition (eq/m2/yr)	Total (Hdep) Deposition (eq)	ANC Change (µeq/l)	Percent ANC Change
Ned Wilson	38.5	1.02	9	1.72×10^{-03}	5.24×10^{-05}	2,236	1.23×10^{-05}	3.27×10^{-07}	0.45	0.01	0.020%
Upper Ned Wilson	12.8	1.02	3	1.72×10^{-03}	5.24×10^{-05}	271	1.23×10^{-05}	3.27×10^{-07}	0.16	0.01	0.061%
Moon	51.5	1.02	251	7.70×10^{-04}	2.36×10^{-05}	$8.83 \times 10^{+04}$	5.50×10^{-06}	1.47×10^{-07}	5.92	0.11	0.007%
Deep Creek[1]	44.3	1.02	360	7.34×10^{-04}	2.32×10^{-05}	$1.09 \times 10^{+05}$	5.24×10^{-06}	1.45×10^{-07}	8.37	0.19	0.008%
South Golden	111	1.02	112	6.33×10^{-04}	2.01×10^{-05}	$8.50 \times 10^{+04}$	4.52×10^{-06}	1.26×10^{-07}	2.25	0.02	0.003%
Dean	57.3	1.02	117	1.00×10^{-03}	3.07×10^{-05}	$4.58 \times 10^{+04}$	7.15×10^{-06}	1.92×10^{-07}	3.59	0.06	0.008%
Pine Island	95.6	1.02	192	9.06×10^{-04}	2.82×10^{-05}	$1.25 \times 10^{+05}$	6.47×10^{-06}	1.76×10^{-07}	5.41	0.06	0.004%

[1] For lakes with existing ANC levels less than 25 microequivalents per liter (µeq/l), a LAC of no greater than one µeq/l is applied. For lakes with existing ANC levels greater than 25 µeq/l, the LAC is no greater than a 10% change in the background ANC.

[2] Assumed to equal to or less than Alternative A.

4.2.3 MITIGATION

Air quality mitigation measures and best management practices (BMPs) would be necessary to reduce predicted air quality impacts from the Proposed Action and alternatives. A complete list of air quality mitigation measures and BMPs (committed to by Gasco and/or required by regulation or policy) are presented in Table 2-1.

Potential additional mitigation measures that could be applied to reduce the impacts to air quality would include the following:

- Best available air quality control technology would be applied as appropriate.

4.2.4 UNAVOIDABLE ADVERSE IMPACTS

Short-term increases in the concentrations of CO, NO_x, SO_2, GHGs, PM_{10}, and $PM_{2.5}$ would be expected to result from this project.

4.2.5 IRREVERSIBLE AND IRRETRIEVABLE EFFECTS

There would be no irreversible impacts to air quality. Air quality would be irretrievably degraded in and around the project area for the life of the project (LOP).

4.2.6 RELATIONSHIP OF SHORT-TERM USES TO LONG-TERM PRODUCTIVITY

Construction of oil and gas facilities and infrastructures would provide a short-term mineral use that would result in temporary impacts to air quality, which would persist throughout the life of the project.

4.3 CULTURAL RESOURCES

Under all alternatives, adverse impacts to historic properties in the project area would include an increased risk of physical alteration, damage, or destruction; and/or alteration of the character or setting of a property. These impacts would result from activities associated with surface or subsurface disturbance (i.e., road building, pipeline construction, and well-pad development). This would specifically apply to archaeological sites or locations determined to be of sacred or traditional importance by Native American tribes where visual impacts and/or increased noise levels may impact that use.

For this project, adverse effects to cultural resources are minimized through compliance with Section 106 of the NHPA, and through compliance with the applicant-committed measures. Compliance with Section 106 mandates the identification of historic properties within the development area that may be affected under each of the alternatives, and provides a framework for consultation to resolve adverse effects. The applicant-committed measures for this project reinforce Section 106 requirements. These measures specifically include intensive-level pedestrian surveys of proposed development areas; archaeological surveys in areas with high site probability; utilization of BLM public outreach opportunities to educate personnel; cessation of construction activities in the event of archaeological discoveries; avoidance of historic properties within proposed development areas; and mitigation of adverse impacts through approved data-recovery plans.

The Vernal RMP cultural resource probability model referenced for this study indicates that approximately 61,791 acres (or approximately 30%) of the 206,826-acre development area are categorized as high-probability zones, where the chances of encountering cultural resources are relatively high. Approximately 145,033 acres (or roughly 70%) within the development area are categorized as low-probability zones, according to the model. These areas have a low chance for containing cultural resources.

For this study, 2 primary indicators of impacts to cultural resources were examined. The first was the total acreage of surface disturbance located within high- and low-sensitivity areas as a result of proposed development (Table 4-66). The second was the linear mileage of new roads constructed in each probability zone under each alternative (Table 4-67); the roads were evaluated due to both their direct disturbance and potential to generate fugitive dust that could affect cultural sites.

Table 4-66. Acres of Surface Disturbance and Percentage of Each Probability Zone in the Project Area Disturbed

Cultural Zone	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
High-probability zone	1,358 (2.2%)	1,124 (1.8%)	1,936 (3.1%)	613 (0.9%)	429 (0.7%)	657 (1.1%)
Low-probability zone	6,226 (4.3%)	4,562 (3.1%)	8,045 (5.5%)	1,442 (0.9%)	1,745 (1.2%)	2,944 (2.0%)
Total	**7,584 (3.7%)**	**5,686 (2.7%)**	**9,981 (4.8%)**	**2,055 (0.9%)**	**2,174 (1.1%)**	**3,601 (1.7%)**

Table 4-67. Miles of New Roads in Each Probability Zone

Cultural Zone	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
High-probability zone	60	60	116	25	24	40
Low-probability zone	266	214	421	47	82	157
Total	**325**	**274**	**537**	**72**	**106**	**197**

In addition to these indicators, the BLM assessed the number of known sites susceptible to adverse effects from visual intrusions related to development of the project area. This analysis is provided in Section 4.3.1.

4.3.1 Direct and Indirect Effects

Cultural resources located in the project area are non-renewable; if not detected, they would be irreversibly damaged by ground-disturbing activities such as seismic operations, site and road construction, and secondary surface activities (e.g., vehicular and pedestrian traffic). Many archaeological sites in the project area are shallow, and cultural deposits could be damaged or destroyed by vegetation clearing, right-of-way (ROW) blading, or soils excavation. Standing historic buildings or structures are more visible than archaeological deposits, and are more easily avoided by ground-disturbing activities. Historic and prehistoric cultural resources may be subject to indirect impacts, including an increased risk of vandalism, surface artifact collection, dust accumulation, visual intrusion, unauthorized excavation, and off-road traffic because of improved access to the area from new and upgraded roads or production and distribution lines. Direct and indirect impacts could result in the loss of research potential or enhancement through scientific study; the loss of recreational opportunities and interpretation; the loss of management options for the BLM; or the alienation of place, setting, and feeling. The degree of threat to cultural resource sites would depend on their location relative to proposed project facilities and new access roads, and the efforts taken by the project proponents to minimize or eliminate the threats at the time facilities are constructed.

Indirect effects from visual intrusions and fugitive dust are essentially the same across all alternatives and are discussed here. The BLM assessed the potential for adverse visual effects on cultural resource sites using available information about known sites to determine which National Register of Historic Places (NRHP)–eligible and unevaluated sites are located within the viewshed of the project area and, of these, which are of a type where visual intrusion could adversely affect the setting, feeling, association, or use of the site. Susceptible sites are generally those with surface structures and features; rockshelters; trails; burials; and rock art. Through the analysis, the BLM identified 703 known sites in the APE—236 of which are located within the project area itself—that may be susceptible to adverse effects from visual intrusion. The severity of the affect on any one site cannot be determined at this time as the exact placement of individual wells and facilities under the various alternatives has not been finalized. To address this, a stipulation has been included in a Programmatic Agreement (PA) executed in conjunction with this EIS to require an evaluation of visual, and other, indirect effects on visually sensitive NRHP-eligible properties within 600 feet of any well pad or new road development. This evaluation, and the implementation of measures to avoid, minimize, or mitigate any adverse effects, would occur at the facility specific permitting stage.

Fugitive dust has the potential to affect cultural resources by coating artifacts, features, and rock art panels with dust. Typical dust suppression methods, including the application of water or chemical suppressants to unimproved roads, are generally sufficient to limit the distance dust travels from its point of origin. As such, those sites directly adjacent to roads or similar facilities would be most at risk. Dust control measures would be required under all alternatives. Some chemical suppressants used in dust control have the potential to accelerate erosion of certain materials and may affect rock art panels in this manner. The highest concentrations of rock art panels in the APE are located in Nine Mile Canyon and the Desolation Canyon NHL. No development or road use related to any of the alternatives would occur within the Desolation Canyon NHL. As such, no indirect effects on cultural resources in the NHL from fugitive dust are anticipated. Development and use of roads in Nine Mile Canyon varies by alternative. Under Alternatives A (Proposed Action), D, and F (Agency Preferred), no development would occur below the canyon rim. Under Alternatives B, C, and E, development, including construction and use of new roads, would occur in the canyon. Table 4-68, below, summarizes the proposed in-canyon development under each alternative. Because Alternative C would have by far the greatest amount of disturbance and road construction in the canyon, it has the highest potential for adverse effects on cultural resources from fugitive dust. Alternatives B and E would have less development in the canyon and would, therefore, pose a much lower risk of impacts on cultural resources from fugitive dust.

4.3.1.1 ALTERNATIVE A: PROPOSED ACTION

Under Alternative A (Proposed Action), developments would directly affect approximately 1,358 acres within high-probability zones, and approximately 6,226 acres within the low-probability zones. The Proposed Action would result in the direct disturbance of 745 more acres within high-probability zones and 4,784 more acres in low-probability zones than Alternative D (No Action Alternative), and would therefore result in a greater risk of adverse impacts to cultural resources. No well pads would be located below the upper rim of Nine Mile Canyon. No roads would be developed below the upper rim of Nine Mile Canyon (Table 4-68). No development of any type would occur in the Desolation Canyon NHL.

Table 4-68. Impacts Below the Upper Rim of Nine Mile Canyon

Cultural Zone	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Number of well pads	0	0	95	0	0	0
Acres of surface disturbance	0	17	562	0	9	0
Miles of roads	0	2	37	0	1	0

Indirect impacts from the Proposed Action would occur along 60 linear miles of new roads in high-probability zones, and 266 linear miles of new roads in low-probability zones. The Proposed Action would result in the location of 35 more miles of new roads in high-probability zones and 219 more miles of new roads in low-probability zones than are proposed in the No Action Alternative, and would therefore result in a greater risk of indirect adverse impacts to cultural resources. (Impacts from increased traffic under the Proposed Alternative are discussed in Section 4.5.1.1.2, Transportation.)

Because more acreage would be disturbed by development under the Proposed Action than under the No Action Alternative, the Proposed Action would likely result in greater potential for data recovery.

4.3.1.2 ALTERNATIVE B: REDUCED DEVELOPMENT

Under Alternative B, direct effects due to surface disturbance would be of the same nature as those described under the Proposed Action. However, under Alternative B, developments would impact approximately 1,124 acres within high-probability zones, and approximately 4,562 acres within the low-probability zones. In effect, 511 more acres in high-probability zones and 3,120 more acres in low-probability zones would be impacted when compared to the No Action Alternative. No well pads would be located below the upper rim of Nine Mile Canyon, although approximately 17 acres of surface disturbance would be expected due to roads or pipelines. Two miles of roads would be developed below the upper rim of Nine Mile Canyon (see Table 4-68). No development of any type would occur in the Desolation Canyon NHL.

Indirect effects due to the development of new roads would also be of similar type to those described in the Proposed Action but would involve the development of 60 miles of new roads in high-probability zones and 214 miles in low-probability zones. Development of new roads under Alternative B would result in 35 more miles of new roads in high-probability zones, and 167 more miles in low-probability zones than are proposed in the No Action Alternative. (Impacts from increased traffic under Alternative B are discussed in Section 4.5.1.2.2, Transportation.)

4.3.1.3 Alternative C: Full Development

As with Alternative B, direct effects under Alternative C due to surface disturbance would be of the same nature as those described under the Proposed Action. Under Alternative C, developments would impact approximately 1,936 acres within high-probability zones, and approximately 8,045 acres within the low-probability zones. A total of 1,323 more acres in high-probability zones and 6,603 more acres in low-probability zones would be impacted when compared to the No Action Alternative. A total of 95 well pads would be located below the upper rim of Nine Mile Canyon, resulting in approximately 562 acres of surface disturbance. Thirty seven miles of roads would be developed below the upper rim of Nine Mile Canyon (see Table 4-68). No development of any type would occur in the Desolation Canyon NHL.

Indirect effects due to the development of new roads would also be of similar type to those described in the Proposed Action, but would involve the development of 116 miles of new road in high-probability zones and 421 miles in low-probability zones. Development of new roads under Alternative B would result in 91 more miles of new roads in high-probability zones and 374 more miles in low-probability zones than are proposed in the No Action Alternative. (Impacts from increased traffic under Alternative C are discussed in Section 4.5.1.3.2, Transportation.)

4.3.1.4 Alternative D: No Action

Under the No Action Alternative, surface disturbance would impact approximately 613 acres within high-probability zones and approximately 1,442 within low-probability zones. Indirect effects as a result of new road development would result in the creation of 25 miles of roads in high-probability areas and 47 miles in low-probability zones. The direct and indirect effects as a result of the No Action Alternative would be of similar type to those outlined under the Proposed Action; however, their extent would be considerably reduced. No well pads would be located below the upper rim of Nine Mile Canyon, and no surface disturbance would be expected due to roads or pipelines. No roads would be developed below the upper rim of Nine Mile Canyon (see Table 4-68). (Impacts from increased traffic under the No Action Alternative are discussed in Section 4.5.1.4.2, Transportation.) No development of any type would occur in the Desolation Canyon NHL.

4.3.1.5 Alternative E: Reduced Development with Directional Drilling

Under Alternative E, surface disturbance would impact approximately 429 acres within high-probability zones and approximately 1,745 within low-probability zones. Indirect effects as a result of new road development would result in the creation of 24 linear miles of roads in high-probability areas and 82 linear miles in low-probability areas. No well pads would be located below the upper rim of Nine Mile Canyon, although approximately 9 acres of surface disturbance would be expected due to roads or pipelines. One mile of roads would be developed below the upper rim of Nine Mile Canyon (see Table 4-68). No development of any type would occur in the Desolation Canyon NHL.

The direct and indirect effects, as a result of Alternative E, would be of similar type to those outlined under the Proposed Action; however, their extent would be considerably reduced. (Impacts from increased traffic under Alternative E are discussed in Section 4.5.1.5.2, Transportation.)

4.3.1.6 Alternative F: Agency Preferred Alternative

Under Alternative F, surface disturbance would impact approximately 657 acres within high-probability zones and approximately 2,944 within low-probability zones. A total of 44 more acres in high-probability zones and 1,502 more acres in low-probability zones would be impacted when compared to the No Action Alternative. Indirect effects as a result of new road development would result in the creation of 40 linear miles of roads in high-probability areas and 157 linear miles in low-probability areas. Development of new roads under Alternative F would result in 15 more miles of new roads in high-probability zones and 110 more miles in low-probability zones than are proposed in the No Action Alternative. No well pads would be located below the upper rim of Nine Mile Canyon. No roads would be developed below the upper rim of Nine Mile Canyon (Table 4-68). No development of any type would occur in the Desolation Canyon NHL.

The direct and indirect effects as a result of Alternative F would be of similar type to those outlined under the Proposed Action; however, their extent would be considerably reduced. (Impacts from increased traffic under Alternative F are discussed in Section 4.5.1.6.2, Transportation.)

4.3.2 Mitigation

Per the PA (Appendix Q) executed for the EIS, all necessary efforts to avoid effects to eligible cultural resources will be made during the planning phases of a particular (facility specific) undertaking. These efforts include, but are not limited to, rerouting pipelines or road corridors and moving well locations or other facilities to avoid direct effects to important resources during the design phase. Indirect effects to eligible cultural resources, where setting is an important aspect of site eligibility, will be minimized or avoided by implementation of measures such as low profile well facilities, screening and facility color selection, mufflers or other noise reducing technologies or adaptations to limit noise.

Potential mitigation under all alternatives could include the following:

- Protective fencing would be placed around the boundaries of historic properties during activities that occur within 150 feet.
- Roads, well-pad construction, and other mineral development–related disturbances in areas with soils susceptible to wind erosion would be surfaced as directed by the AO to reduce fugitive dust generated by traffic and related activities. (Surfacing involves the covering of piles where appropriate, the laying of gravel, or the application of water to roads, etc.). Such treatments would also be applied as directed by the AO on local and resource roads that represent a dust problem.
- Shovel testing would be conducted at historic properties with suspected subsurface deposits in order to further determine the potential for additional data recovery.
- Diagnostic artifacts would be collected from the surface of sites located within 150 feet of proposed development areas for curation and analysis.

- Data recovery would be required at NRHP-eligible sites that cannot be avoided by proposed development.
- Surface-disturbing activities would be located a minimum of 0.5 mile from sensitive cultural resources, as identified by the AO through site-specific consultation with the State Historic Preservation Officer (SHPO) and any affected Native American tribes.
- All applicable fluid minerals BMPs from Appendix R of the Vernal RMP (BLM 2008c) would be implemented.

4.3.3 Unavoidable Adverse Impacts

For each alternative in this study, there is potential for unavoidable adverse impacts to cultural resources despite compliance with Section 106 and applicant-committed measures. The greatest risk is the destruction of or impacts to unknown and undetected sites. As indicated in the previous section, adherence to relevant cultural resource laws would provide opportunities for mitigation of the majority of these impacts.

4.3.4 Irretrievable and Irreversible Commitments of Resources

The location and nature of all cultural resources in the study area is unknown. It is therefore not possible to determine if there would be irreversible and/or irretrievable impacts to cultural resources, or what these impacts might be. All of the alternatives being considered have the potential for causing impacts. Following all relevant cultural resource laws would provide opportunities to minimize the impacts and gather additional information regarding these resources. However, any physical impact to a cultural resource is essentially impossible to restore. Accordingly, there is some risk of irreversible impacts to cultural resources if these resources are unknown and are not detected during project implementation.

4.3.5 Relationship of Short-term Uses to Long-term Productivity

Proper mitigation and compliance with Section 106 would reduce but not eliminate impacts to long-term productivity of cultural resources due to short-term oil and gas development. Short-term oil and gas development, therefore, would impact long-term productivity of cultural resources via the destruction of these resources during ground-disturbing activities.

4.4 Geology and Minerals

Under all of the alternatives, impacts to exploration and development of resources in the area would include tar sands, other leasable minerals (including gilsonite and oil shale), and mineral materials (including gravel and building stone).

4.4.1 DIRECT AND INDIRECT EFFECTS

4.4.1.1 ALTERNATIVE A: PROPOSED ACTION

4.4.1.1.1 OIL AND GAS RESOURCES

Under the Proposed Action, potential impacts to oil and gas resources would include the depletion of natural gas resources due to active extraction. Assuming a maximum development of 1,491 wells, the Proposed Action would yield approximately 1.57 trillion cubic feet (Tcf) of natural gas over the life of the project. Table 4-69 shows the estimated amount of gas that would be extracted under each of the alternatives assuming 1,052,985 thousand cubic feet (Mcf) would be extracted per well over the life of the project.

Table 4-69. Natural Gas Produced by Alternative[1]

	Alternative A (Proposed Action)	Alternatives B and E (Reduced and Directional)	Alternative C (Full)	Alternative D (No Action)	Alternative F (Agency Preferred)
Number of wells	1,491	1,114	1,887	368	1,298
Gas produced (Tcf)	1.57	1.17	1.99	0.39	1.37
Percentage of total reserves[2]	7.1%	5.3%	9.0%	1.8%	6.2%

[1]Assuming 1,052,985 Mcf per well.
[2]Assuming a mean estimate of 22 Tcf of gas reserves in the Uinta Basin.

The U.S. Departments of the Interior, Agriculture, and Energy 2003 inventory of onshore federal lands' oil and gas resources and reserves estimated that there is currently a mean estimate of 22 Tcf of natural gas reserves in the Uinta/Piceance Basin (USDOI et al. 2003). Gasco estimates that the Proposed Action would yield approximately 1.57 Tcf of natural gas over the life of the project, decreasing the presumed total available reserves of the Uinta Basin by approximately 7.1%. Additionally, under the Proposed Action, there would be approximately 3.9 times the depletion of gas resources as under the No Action Alternative.

In addition to natural gas extraction, adverse impacts to future and existing oil and gas leases are also anticipated. Table 4-70 shows the number of acres and the overall percentage of the project area that would be impacted by the Proposed Action.

Table 4-70. Acres of Surface Disturbance in Areas Open to Oil and Gas Leasing

	Alternative A (Proposed Action)		Alternative B (Reduced)		Alternative C (Full)		Alternative D (No Action)		Alternative E (Directional)		Alternative F (Agency Preferred)	
	Acres	% of Total	Acres	% of Total	Acres	% of Total	Acres	% of Total	Acres	% of Total	Acres	% of Total
Oil and gas	6,213	3.6%	4,475	2.5%	8,423	4.8%	1,535	0.9%	1,737	1.0%	2,971	1.7%

Because these resources are below the surface, they are not susceptible to surface disturbing activities. However, impacts to subsurface resources include potential contamination of the resource from drilling fluids and physical obstructions from well casings. Additionally, increased access to these areas may result in a more rapid development of the area.

Due to the minimal presence of tar sand resources in the project area, potential impacts to tar sands from the Proposed Action are expected to be negligible. The proposed development would impact 6,213 acres (3.6%) open to oil and gas leases in the area, which is approximately 4 times the 1,535 acres that would be impacted under the No Action Alternative.

4.4.1.1.2 Special Tar Sands Areas

Under the Proposed Action, no Special Tar Sand Area (STSA) acres would be impacted by surface disturbance. Table 4-71 shows the number of acres and the overall percentage of STSAs in the project area that would be impacted by each alternative. None of the project area is open to commercial tar sand leasing (BLM 2008a), so there would be no impacts to tar sands that are available for leasing.

Table 4-71. Acres of Tar Sands Impacted

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Acres	0	0	104*	0	0	103*
STSAs in project area impacted (%)	0.0%	0.0%	3.8%	0.0%	0.0%	3.7%

* None of the project area is open to commercial tar sand leasing, so there would be no impacts to tar sands that are available for leasing

4.4.1.1.3 Other Leasable Minerals (Oil Shale and Gilsonite)

Impacts to subsurface resources such as oil, shale, and gilsonite include potential contamination of the resource from drilling fluids, and the physical obstruction from well casings. However, due to the number of acres proposed for development, impacts to gilsonite leasing areas are expected to be negligible, and impacts to oil shale leasing areas are expected to be minor. Approximately 1 acre of gilsonite leasing areas and 3,561 acres of oil shale leasing areas would be impacted by the Proposed Action (Table 4-72). Although some lands in the project area are designated as open to oil shale leasing, development and production of oil shale in those lands is unlikely during the life of the Gasco project (BLM 2008b). The Proposed Action could make these areas difficult to develop in the future due to surface-disturbing activities. Because these resources are found below the surface, development would be difficult because existing gas production facilities occupying the land would prohibit access to areas below the facilities. Table 4-72 shows the number of acres of gilsonite and oil shale leasing areas that would be impacted by the Proposed Action, as well as the percentage those acreages represent for the entire project area.

Table 4-72. Acres of Gilsonite and Oil Shale Impacted

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Gilsonite						
Acres	1	1	0	1	0	0
Resource in project area (%)	5.6%	5.6%	0.0%	5.6%	0.0%	0.0%
Oil Shale						
Acres open to commercial oil shale leasing	3,561	2,691	4,214	983	1,076	1,283
Resource in project area (%)	4.4%	3.3%	5.2%	1.2%	1.3%	1.6%

4.4.1.1.4 Locatable Minerals (Uranium and Placer Gold)

Potential impacts to uranium and gold would be negligible because there are currently no mining claims in the project area (BLM 2008b). Additionally, there is a low potential for new mining claims to be issued over the life of the Gasco project due to regulatory requirements and low economic quality and quantity of deposits in the project area (see Section 3.4, Geology and Minerals).

4.4.1.1.5 Salable Minerals (Decorative Rock/Building Stone, and Gravel)

Potential impacts to gravel resources are not anticipated in the project area because more convenient supplies are located on other public lands within the Uinta Basin (BLM 2008b). Potential adverse impacts to building stone/decorative rock could result from proposed access roads and their potential to increase opportunities to collect these resources. Additionally, because decorative rock is an aboveground resource, it is susceptible to surface disturbing activities. Table 4-73 shows the number of acres of salable mineral materials that would be impacted by the Proposed Action, as well as the percentage that those acreages represent for the entire project area. The Proposed Action and Alternative C would have greater impacts to decorative rock resources (1,049 and 1,582 acres open to development, respectively) than Alternative B, Alternative E, and the No Action Alternative (450, 276, and 264 acres open to development, respectively). However, because there are more accessible supplies of salable mineral outside the project area, the impact from this alternative is negligible.

Table 4-73. Acres of Salable Minerals Impacted

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Acres	1,049	450	1,582	264	276	522
Resource in project area (%)	3.8%	1.6%	5.7%	1.0%	1.0%	1.9%

4.4.1.2 Alternative B: Reduced Development

4.4.1.2.1 Oil and Gas Resources

Under Alternative B, 746 more wells would be developed than under the No Action Alternative (Table 4-69). As such, there would also be 0.78 Tcf more natural gas extracted, as well as greater disturbance to geologic formations. Alternative B would impact 4,475 acres (2.5%) of the area open to oil and gas leasing in the project area, which is approximately 3 times the area disturbed under the No Action Alternative (Table 4-70).

4.4.1.2.2 Special Tar Sands Areas (STSAs)

Alternative B (Reduced Development) would not impact any STSAs. Therefore, with no acres impacted, potential impacts to tar sand resources from Alternative B are expected to be negligible (Table 4-71).

4.4.1.2.3 Other Leasable Minerals (Oil Shale and Gilsonite)

Alternative B would impact 1 acre of gilsonite, which would be the same as under the No Action Alternative (Table 4-72). This is approximately 6% of all acres of gilsonite open to leasing in the project area. Alternative B would also impact 2,691 acres of oil shale open to leasing, which is more than twice the acres of impact to oil shale than would occur under the No Action Alternative. This is approximately 3.3% of all acres of oil shale leasing areas in the project area. Therefore, impacts to gilsonite and oil shale leasing areas are expected to be negligible.

4.4.1.2.4 Locatable Minerals (Uranium and Placer Gold)

Potential impacts to uranium and gold would be the same as those discussed under the Proposed Action.

4.4.1.2.5 Salable Minerals (Decorative Rock/Building Stone and Gravel)

Alternative B would impact 450 acres of salable minerals (1.6% of total in project area). This is 1.7 times the acres of salable minerals than would be impacted under the No Action Alternative (Table 4-73). However, because there are more accessible supplies of salable mineral outside the project area (BLM 2002a), the impact from this alternative is negligible.

4.4.1.3 Alternative C: Full Development

4.4.1.3.1 Oil and Gas Resources

Under Alternative C, 1,519 more wells would be developed than under the No Action Alternative (Table 4-69). As such, there would also be 1.60 Tcf more natural gas extracted, as well as greater disturbance to geologic formations. Alternative C would impact 8,423 acres (4.8%) of the area open to oil and gas leasing in the project area, which is approximately 5.5 times the area disturbed under the No Action Alternative (Table 4-70).

4.4.1.3.2 Special Tar Sands Areas

Under this alternative, 104 acres of tar sands would be disturbed. This is approximately 4% of the total acres of tar sands in the project area (Table 4-71). Alternative C would make the impacted areas difficult to develop in the future due to surface disturbing activities. Because these resources are found below the surface, development would be difficult because existing gas production facilities occupying the land would prohibit access to areas below the facilities. Impacts to subsurface resources include potential contamination of the resource from drilling fluids and physical obstructions from well casings.

4.4.1.3.3 Other Leasable Minerals (Oil Shale and Gilsonite)

Alternative C would not impact any acres open to leasing for gilsonite, which is fewer than under the No Action Alternative (Table 4-72). The alternative would impact 4,214 acres of oil shale open to leasing (5.2% of total oil shale leasing areas in project area), which is more than 4 times the acres of oil shale than would be impacted under the No Action Alternative.

4.4.1.3.4 Locatable Minerals (Uranium and Placer Gold)

Potential impacts to uranium and gold would be the same as those discussed under the Proposed Action.

4.4.1.3.5 Salable Minerals (Decorative Rock/Building Stone and Gravel)

Alternative C would impact 1,582 acres of salable minerals (5.7% of total in project area), which is approximately 6 times more acres of salable minerals open to leasing than would be impacted under the No Action Alternative (Table 4-73). However, because there are more accessible supplies of salable mineral outside the project area, the impact from this alternative is negligible.

4.4.1.4 Alternative D: No Action

4.4.1.4.1 Oil and Gas Resources

Under the No Action Alternative, 368 wells would be developed (Table 4-69) and 0.39 Tcf of natural gas would be extracted. The No Action Alternative would impact 1,535 acres (0.9%) of the area open to oil and gas leasing in the project area (Table 4-70).

4.4.1.4.2 Special Tar Sands Areas

Under the No Action Alternative, there are no acres of tar sands impacted. Therefore, potential impacts to tar sand resources from the No Action Alternative are expected to be negligible (Table 4-71).

4.4.1.4.3 Other Leasable Minerals (Oil Shale and Gilsonite)

The No Action Alternative would impact 1 acre of gilsonite and 983 acres of oil shale open to leasing (Table 4-72). This is approximately 6% of all acres of gilsonite and 1.2% of all acres of oil shale open to leasing in the project area.

4.4.1.4.4 Locatable Minerals (Uranium and Placer Gold)

Potential impacts to uranium and gold would be the same as those discussed under the Proposed Action.

4.4.1.4.5 Salable Minerals (Decorative Rock/Building Stone and Gravel)

The No Action Alternative would impact 264 acres of salable minerals, which is fewer than under any of the other alternatives (Table 4-73).

4.4.1.5 Alternative E: Reduced Development with Directional Drilling

4.4.1.5.1 Oil and Gas Resources

Under Alternative E, 746 more wells would be developed than under the No Action Alternative (Table 4-69). As such, there would also be 0.78 Tcf more natural gas extracted, as well as greater disturbance to geologic formations. Alternative E would impact 1,737 acres (1.0%) of the area open to oil and gas leasing in the project area, which is approximately 200 more acres than would be disturbed under the No Action Alternative (Table 4-70).

4.4.1.5.2 Special Tar Sands Areas

Alternative E would not impact any tar sand areas. Therefore, with no acres impacted, potential impacts to tar sand resources from Alternative E are expected to be negligible (Table 4-71).

4.4.1.5.3 Other Leasable Minerals (Oil Shale and Gilsonite)

Alternative E would not impact any acres of gilsonite open to leasing, which would be fewer than the No Action Alternative (Table 4-72). Alternative E would impact 1,076 acres of oil shale open to leasing, which is slightly more impact to oil shale than under the No Action Alternative. This is approximately 1.3% of all acres of oil shale in the project area. Therefore, impacts to gilsonite and oil shale are expected to be negligible.

4.4.1.5.4 Locatable Minerals (Uranium and Placer Gold)

Potential impacts to uranium and gold would be the same as those discussed under the Proposed Action.

4.4.1.5.5 Salable Minerals (Decorative Rock/Building Stone and Gravel)

Alternative E would impact 276 acres of salable minerals open to leasing (1.0% of the project area's), which is 5 more acres of salable minerals than would be impacted under the No Action Alternative (Table 4-73). However, because there are more accessible supplies of salable mineral outside the project area, the impact from this alternative is negligible.

4.4.1.6 ALTERNATIVE F: AGENCY PREFERRED ALTERNATIVE

4.4.1.6.1 OIL AND GAS RESOURCES

Under Alternative F, 930 more wells would be developed than under the No Action Alternative (Table 4-69). As such, there would also be 0.98 Tcf more natural gas extracted, as well as greater disturbance to geologic formations. Alternative F would impact 2,971 acres (1.7%) of the area open to oil and gas leasing in the project area, which is approximately 1,400 more acres than would be disturbed under the No Action Alternative (Table 4-70).

4.4.1.6.2 SPECIAL TAR SANDS AREAS

Under this alternative, 103 acres of tar sands would be disturbed. This is approximately 4% of the total acres of tar sands in the project area (Table 4-71). Alternative F would make the impacted areas difficult to develop in the future due to surface disturbing activities. Because these resources are found below the surface, development would be difficult because existing gas production facilities occupying the land would prohibit access to areas below the facilities. Impacts to subsurface resources include potential contamination of the resource from drilling fluids and physical obstructions from well casings.

4.4.1.6.3 OTHER LEASABLE MINERALS (OIL SHALE AND GILSONITE)

Alternative F would not impact any acres of gilsonite open to leasing, which would be fewer than the No Action Alternative (Table 4-72). This alternative would impact 1,283 acres of oil shale open to leasing, which is slightly more impact to oil shale than under the No Action Alternative. This is approximately 1.6% of all acres of oil shale in the project area. Therefore, impacts to gilsonite and oil shale are expected to be negligible.

4.4.1.6.4 LOCATABLE MINERALS (URANIUM AND PLACER GOLD)

Potential impacts to uranium and gold from Alternative F would be the same as those discussed under the Proposed Action.

4.4.1.6.5 SALABLE MINERALS (DECORATIVE ROCK/BUILDING STONE AND GRAVEL)

Alternative F would impact 522 acres of salable minerals open to leasing (1.4% of total in the project area), which is 258 more acres of salable minerals than would be impacted under the No Action Alternative (Table 4-73). However, because there are more accessible supplies of salable mineral outside the project area, the impact from this alternative is negligible.

4.4.2 MITIGATION

All applicable Fluid Minerals BMPs from Appendix R of the Vernal RMP (BLM 2008c) would be incorporated as needed to avoid resource conflicts or impacts to mineral resources.

4.4.3 Unavoidable Adverse Impacts

Unavoidable adverse impacts to mineral resources would include the potential to adversely impact tar sands, gilsonite, and oil shale through contamination of the resource by drilling fluids and physical obstruction of resources by well casings, as well as surface disturbance in areas open to salable mineral leasing. This would occur under all of the alternatives to varying degrees, depending on the number of wells.

4.4.4 Irretrievable and Irreversible Commitments of Resources

Irretrievable and irreversible resources would include tar sands, gilsonite, and oil shale through contamination of the resource by drilling fluids, and physical obstruction of resources by well casings. There would also be irretrievable and irreversible impacts to salable minerals because of surface disturbance in areas open to salable mineral leasing. This would occur to varying degrees under all of the alternatives, depending on the number of wells. All natural gas that is extracted from the project area would be removed irreversibly for future extraction.

4.4.5 Relationship of Short-term Uses to Long-term Productivity

Because of subsurface impacts to mineral resources, short-term uses would have an adverse impact on long-term productivity for tar sands, gilsonite, and oil shale in the immediate location of wells. Surface disturbance at well sites would primarily affect long-term productivity for surface resources (such as salable minerals). However, because the acres of mineral resources impacted by all alternatives would be low, and better availability of some resources exist outside the project area, overall long-term impacts to the productivity of mineral resources would be minor.

4.5 Land Use and Transportation

All the alternatives would impact federal, state, and private landowners in the project area through the development of wells and associated access roads, pipelines, and facilities. In addition, all alternatives would increase the vehicular traffic in the project area and the surrounding region, thereby potentially increasing the maintenance required for area roads, increasing delays by other users, and increasing the risk of traffic accidents. Each alternative would also increase the size of the project area's road network.

4.5.1 Direct and Indirect Effects

4.5.1.1 Alternative A: Proposed Action

4.5.1.1.1 Land Use

Under Alternative A (Proposed Action), development of 1,491 wells and associated access roads and facilities would result in the disturbance of approximately 7,584 acres during the 15-year construction period. Approximately 85% of the proposed surface disturbance would occur on BLM-administered federal lands (Table 4-74). Of the remaining disturbance, approximately 12% would occur on state lands (more than 99% of which are Utah School and Institutional Trust Lands Administration [SITLA] lands), and approximately 2% would occur on private lands (see

Table 4-74). Placement of well pads and easements on state and private lands (i.e., exact locations of surface disturbance) would be negotiated with the respective landowner, and secured through the permitting process of the appropriate state and local agencies. The Proposed Action would result in 5,528 more acres of surface disturbance to all landowners than the No Action Alternative, and would have relatively greater impacts to BLM and private land (as a percentage of all impacts) than to state lands.

Potential adjustments to existing land uses would include increased access to the project area for gas development and production activities due to road construction. Long-term losses of livestock forage due to surface disturbance would occur, as would long-term losses of wildlife habitat and short-term displacement of wildlife from the project area due to surface disturbance and human/equipment activity in the area. There would also be temporary visual and traffic impacts to recreational users. (Effects on livestock forage and rangeland management are detailed in Section 4.6, Livestock Management. Effects on wildlife habitat are discussed in Section 4.16, Wildlife. Effects on recreation are discussed in Section 4.8, Recreation.)

Table 4-74. Acres of Surface Disturbance by Landowner and Alternative

Landowner	Project Area Managed by Landowner	Acres and Percentage of Surface Disturbance by Landowner					
		Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
BLM	85%	6,280 (83%)	4,475 (79%	8,447 (85%)	1,535 (75%)	1,737 (80%)	2,977 (83%)
State of Utah (>99% SITLA)	12%	1,169 (15%)	1,113 (20%)	1,412 (14%)	497 (24%)	393 (18%)	577 (16%)
Private	2%	135 (2%)	97 (2%)	123 (1%)	24 (1%)	43 (2%)	47 (1%)

Land management and various owners' resources would be affected by numerous other short- and long-term impacts, as described below. Because all right-of-ways (ROWs) in the project area are well-field related (Table 3-13) and all pipeline road crossings would be buried, no adverse impacts to these ROWs would occur.

4.5.1.1.2 TRANSPORTATION

Impacts due to increased traffic include the possibility of delays for recreational users, increased risk of traffic accidents and collisions with wildlife, accelerated road degradation, increased traffic volume, and expansion of the road network. Vehicle traffic would be the highest during the development stage of the Proposed Action. Vehicles would be used to transport equipment and personnel to the project area for construction of well pads, pipelines, roads, and ancillary features, as well as for the drilling and completion of wells. Table 4-75 shows estimates of the project's vehicle use during all development phases.

The following analysis conservatively assumes that project-related vehicles would operate 365 days a year, that well drilling would be spread over 15 years, that each well would produce for 25 years, that vehicle use would be evenly spread over a 12-hour work day, and that all construction trips and workovers would occur in each well's first year. In addition, it assumes that each well would require a total of 1,700 roundtrip visits prior to abandonment, including a total of 1,078 trips by larger trucks, including tankers, drilling rigs, semi-trucks, water trucks, etc. (see Table 2-4). Based on these assumptions, a maximum of 385 vehicles per day (115 pickups and 270 large vehicles) would be expected to make trips within the project area during the phase of the project when vehicles required for construction, completion, and production would all be operating simultaneously (Figure 4-3). This corresponds to maximum of 140,513 visits per year (42,103 pickups and 98,410 large vehicles), or 2,556,992 visits over the entire lifespan of the Proposed Action (927,402 pickups and 1,629,590 large vehicles) (see Table 4-75).

The bulk of transportation impacts would be concentrated in areas of active development during the initial construction and production phase, which would migrate as construction was completed in one area and shifted to another. There would be far less vehicle traffic during the production-only and abandonment phases (see Figure 4-3) of the Proposed Action, and traffic would be more evenly distributed over the entire project area.

It is unlikely that frequent delays to non-project traffic would result from the Proposed Action. Assuming a 12-hour workday, the highest volume of traffic expected under the Proposed Action would average 1 vehicle every 114 seconds during the peak of well construction and production (in approximately 2026). However, this average was calculated by evenly distributing the maximum total daily traffic volume (during the life of the project) over a 12-hour workday. Therefore, it may underestimate the minimum interval on major collector roads during the morning and evening if the majority of production traffic uses a limited number of routes; it may overestimate the interval on dispersed rural routes and access roads.

Table 4-75. Estimated Vehicle Trips by Alternative

	Pickup Truck						Large Vehicle[1]					
	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Total trips (LOP)	927,402	863,436	1,171,923	228,547	843,486	768,312	1,629,590	1,598,679	2,059,529	401,646	1,591,554	1,410,187
Maximum trips per year	42,103	40,218	53,286	10,392	39,546	37,976	98,410	96,746	124,547	24,289	96,395	90,172
Maximum trips per day	115	110	146	28	108	104	270	265	341	67	264	247

	All Vehicles					
	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Minimum interval between trips[2] (seconds)	114	116	90	460	117	123
Maximum increase over current traffic volume (%)[3]	4.9%	4.8%	6.2%	1.2%	4.8%	4.5%

[1] Large vehicles include semi-trucks, water trucks, oil tankers, welding trucks, sand trucks, pump trucks, and trucks carrying other specialized equipment.
[2] Calculated by evenly distributing the maximum total daily traffic volume (during the life of the project) over a 12-hour workday. It likely underestimates the minimum interval on major collector roads during the morning and evening, and overestimates the interval on dispersed rural routes and access roads.
[3] Assumes that all project-related traffic would travel on U.S. Highway 40 near Myton, Utah, and is based on this road segment's average 2009 daily traffic volume.

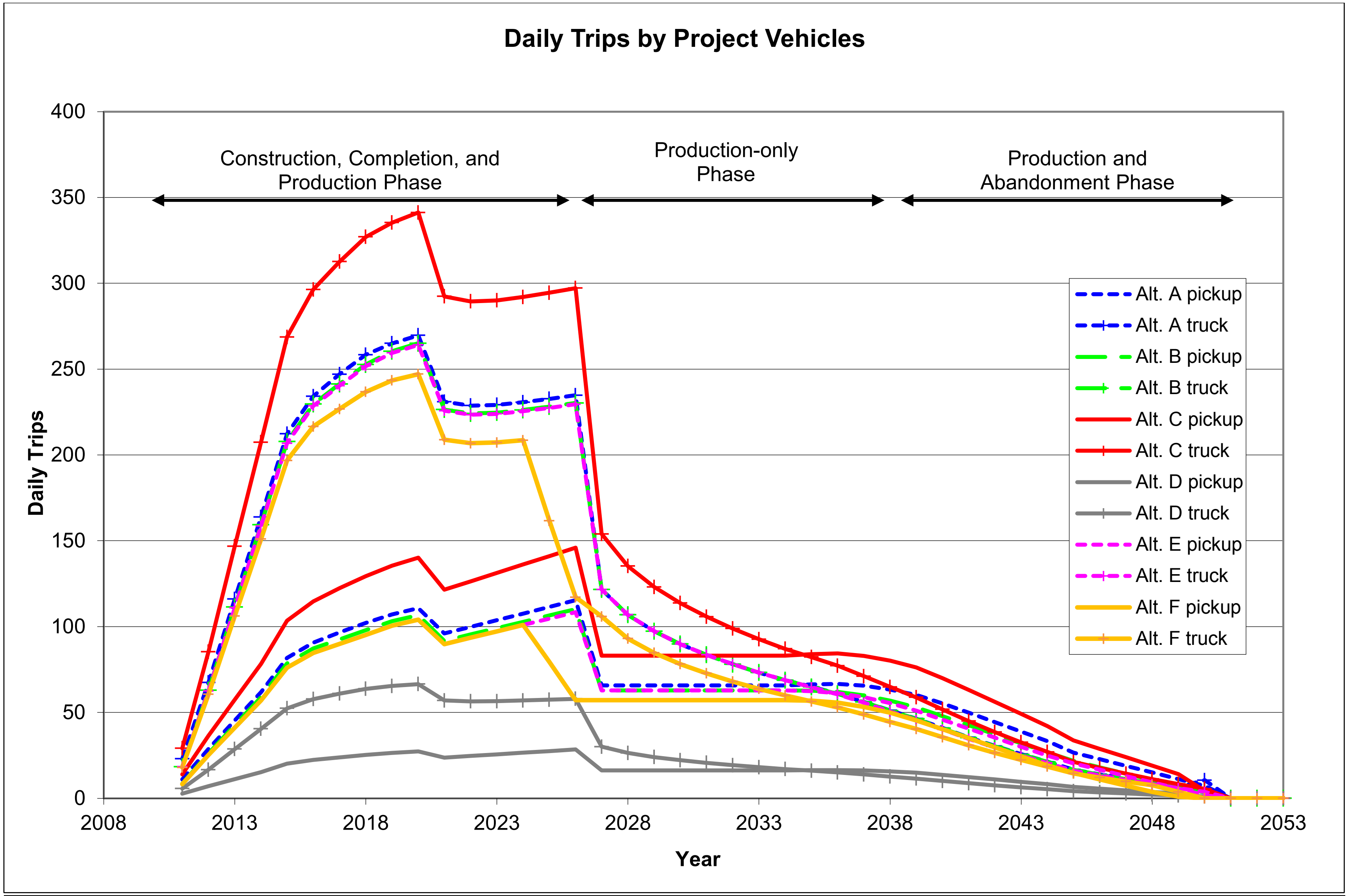

Figure 4-3. Daily trips by project vehicles over the life of the project.

Because these vehicles would be spread across the project area at that point, localized delays would be expected primarily during large equipment mobilizations. Delays would be most likely in the morning and evening hours. Impacts to major roads would also be spread over a variety of roads. Highway 40 east of Myton (the least-used section between Vernal and the project area) averaged 7,798 vehicle trips/day in 2009 (UDOT 2009). At the peak of the construction and production period, the Proposed Action would generate approximately 385 vehicle roundtrips per day (see Figure 4-3), or a 4.9% increase over 2009 average daily traffic volume if all project traffic were to use this particular section of road (a conservative scenario). No data are available on road delays or the level of service this road currently provides, so it is impossible to determine the impact that the project would have on these criteria. Because traffic volumes on other sections of Highway 40 are higher than this section, the percentage that traffic would be increased on other segments would be lower (UDOT 2006).

The primary arteries for project-related transportation are shown in Map 26 and described in Table 4-76, which includes the number of wells that would be serviced via each of the artery road segments in the project area. These main roads include Sand Wash Road, Wells Draw Road, Eightmile Flat Road, Four Mile Wash Road, Wrinkle Road, and Gate Canyon Road.

The main roads used by recreational and tourist traffic within the project area are the Nine Mile Canyon Backcountry Byway and Sand Wash Road. The portion of the Nine Mile Canyon Backcountry Byway within the project area encompasses the following six road segments (segments listed from south to north, see Map 26):

- Nine Mile Canyon Road–From Gate Canyon Road to the west
- Franks Road–Nine Mile Canyon Road to the east of Franks Road
- Gate Canyon Road/Gate Canyon Upper Bench to Nine Mile Canyon Road
- Gate Canyon Road/Wrinkle Road to Gate Canyon Upper Bench
- Wells Draw Road/Sand Wash Road to Wrinkle Road
- Sand Wash Road/Highway 40 to Wells Draw Road

Users of the Nine Mile Canyon Backcountry Byway would experience no project traffic below the rim of Nine Mile Canyon on segments 1, 2, and 3 above (see also Table 4-76). These segments would also not carry any traffic under the No Action Alternative. As shown in Table 4-76, above Gate Canyon, users would experience progressively more project traffic on the remaining three portions of the Nine Mile Canyon Backcountry Byway. From south to north:

- Gate Canyon Road/Wrinkle Road to Gate Canyon Upper Bench: approximately 3% of project traffic (or a maximum of 12 vehicles per day). This would be approximately 12 times as much traffic as would occur on this segment under the No Action Alternative (as noted in Section 3.5, Land Use and Transportation, there is no baseline traffic data for this portion of the Nine Mile Canyon Backcountry Byway against which to compare project traffic).
- Wells Draw Road/Sand Wash Road to Wrinkle Road: approximately 31% of project traffic (or a maximum of 119 vehicles per day). This is approximately 4 to 5 times as much traffic as would occur on this segment under the No Action Alternative (there is no baseline traffic data for this portion of the Nine Mile Canyon Backcountry Byway against which to compare project traffic).

- Sand Wash Road/Highway 40 to Wells Draw Road: 100% of project traffic (or a maximum of 385 vehicles per day). This is approximately 4 times as much traffic as would occur on this segment under the No Action Alternative (there is no baseline traffic data for this portion of the Nine Mile Canyon Backcountry Byway against which to compare traffic).

The Sand Wash Road/Highway 40 to Wells Draw Road segment would also be traveled by the majority of vehicles traveling to the Sand Wash boat ramp on the Green River. Sand Wash Road users would experience progressively less traffic from this point as they traveled toward the Green River. Between 64 and 69% of project traffic (or a maximum of 235 to 266 vehicles per day) would occur on the portion of Sand Wash Road between the Wells Draw Road intersection and Big Wash Road (the turnoff to Eightmile Flat Road) From 7% to 37% of project traffic (or a maximum of 27 to 142 vehicles per day) would occur between Eightmile Flat Road turnoff and Wrinkle Road (see Map 26). This is between 7 and 10 times as much traffic as would occur on these segments under the No Action Alternative. No project traffic would continue past Wrinkle Road toward the Green River.

Increased vehicle traffic, particularly of heavy vehicles, would also lead to an increase in observable road damage, and increased expense for maintaining public roads used by project vehicles. The degree of observable damage would depend on the road maintenance schedule and any increases in road maintenance budgets. This alternative would result in approximately 4.1 times as much project-related traffic than the No Action Alternative, and would therefore have correspondingly larger impacts on public and private roadways used by project vehicles.

Nine Mile Canyon's National Backcounty Byway designation is based on the profusion of Fremont culture rock panels and cliff granaries located along the main road and up side canyons (see Section 3.5, Land Use and Transportation). Under this alternative, there would be no additional traffic below the rim, where these sites are located, and the Nine Mile Canyon Backcountry Byway would continue to possess the elements that resulted in its designation.

Table 4-76. Main Access Routes in the Project Area, and the Number of Wells (and Percentage of the Alternative's Total) They Would Service under Each Alternative

Road Segment	Length (Miles)	Alternative A (Proposed Action)	Alternatives B and E (Reduced and Directional)	Alternative C (Full)	Alternative D (No Action)	Alternative F (Agency Preferred)
Sand Wash Road–Highway 40 to Wells Draw Road[1,2]	2	1,491 (100%)	1,114 (100%)	1,887 (100%)	368 (100%)	1,298 (100%)
Sand Wash Road–Wells Draw Road to Pariette Bench Road[2]	10	1,034 (69%)	773 (69%)	1,209 (64%)	268 (73%)	873 67%)
Sand Wash Road–Pariette Bench Road to Big Wash Road[2]	6	913 (61%)	726 (65%)	1,085 (58%)	241 (65%)	816 (63%)
Sand Wash Road–Eightmile Flat Road to Desert Spring Wash Road[2]	7	549 (37%)	405 (36%)	555 (29%)	57 (15%)	531 (41%)
Sand Wash Road–Desert Spring Wash Road to Cut-off to Wrinkle Road[2]	7	104 (7%)	49 (4%)	171 (9%)	15 (4%)	99 (8%)
Wells Draw Road–Sand Wash Road to Wrinkle Road[1]	25	457 (31%)	341 (31%)	678 (36%)	100 (27%)	425 (33%)
Eightmile Flat Road–Sand Wash Road to Pariette Bench Road via cut-off	11	131 (9%)	102 (9%)	207 (11%)	90 (24%)	85 (7%)
Eightmile Flat Road–Pariette Bench Road to Cut-off to Pariette Bench Road	4	96 (6%)	38 (3%)	95 (5%)	17 (5%)	57 (4%)
Pariette Bench Road–Sand Wash Road to Eightmile Flat Road	14	121 (8%)	47 (4%)	124 (7%)	27 (7%)	57 (4%)
Four Mile Wash Road	8	211 (14%)	200 (18%)	270 (14%)	58 (16%)	184 (14%)
Wrinkle Road–Wells Draw Road to Franks Road	11	170 (11%)	69 (6%)	143 (8%)	13 (4%)	153 (12%)
Wrinkle Road–Cut-off from Sand Wash Road to Franks Road	11	18 (1%)	12 (1%)	82 (4%)	5 (1%)	16 (1%)
Gate Canyon Road–Wrinkle Road to Gate Canyon Upper Bench[1]	1	48 (3%)	37 (3%)	52 (3%)	4 (1%)	44 (3%)
Gate Canyon Road–Gate Canyon Upper Bench to Nine Mile Canyon Road[1]	4	0 (0%)	0	18 (1%)	0	0
Nine Mile Canyon Road– From Gate Canyon Road to the west[1]	3	0 (0%)	0	12 (0.6%)	0	0
Franks Road–Nine Mile Canyon Road to the east of Franks Road[1]	8	0 (0%)	0	1 (0.1%)	0	0

[1]Road segments that are part of the Nine Mile Canyon National Backcountry Byway.
[2]Road segments typically used to access Sand Wash boat ramp.

Increased vehicle use would also increase the risk of traffic accidents and collisions with wildlife. It is difficult to predict the impact of increased traffic on driver safety. However, if each trip expected under the Proposed Action were assumed to average 80 miles, approximately 204,559,344 miles of driving would be directly attributable to the Proposed Action. Applying the national rate of 1.47 crash-related fatalities per 100 million miles driven (Insurance Information Institute of America 2006) as a rough estimate, the risk of approximately three additional traffic fatalities could result from the Proposed Action over approximately 45 years. Uintah County had seven traffic fatalities in 2006, and Duchesne County had six fatalities (Zerofatalities 2007). Therefore, an increased risk of three fatalities over 45 years corresponds to an annual increase of less than 1% within these 2 counties. Applying national rates of 68 accidents with injuries (and 161 accidents resulting in only property damage) per 100 million miles driven equates to a risk of approximately 139 accidents with injuries, and 329 property-damaging accidents that could result under the Proposed Action over the 45-year project lifespan. However, this likely greatly overestimates the actual increased risk of accidents and miles traveled, because speeds in the project area are generally far slower than the where the majority of the miles that contribute to the national average are driven. However, because the same assumptions were used for each alternative, these estimates provide a very conservative basis of comparison between the alternatives.

Additional roads created to implement the Proposed Action would be the responsibility of the owner. Anticipated traffic under the Proposed Action would likely increase the wear on these roads proportional to the increase in traffic volume (approximately 4.9%). Additionally, the Proposed Action would add approximately 325 miles of new roads within the project area, an increase of 11% over the current 3,000-mile road network (Table 4-77). This increased transportation network would have a beneficial impact for many road users by expanding access to many parts of the project area for resource extraction activities, livestock grazing, and recreational activities.

Table 4-77. Road Network Expansion in the Project Area under Each Alternative

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Miles of new road	325	274	526	72	106	198
Increase over current network (%)	11%	9%	18%	2%	4%	7%

An expanded road network would also have an impact on a number of natural resources. Increased recreational access and unauthorized off-road travel due to the Proposed Action would create numerous additional impacts. (These impacts are described in Section 4.2, Air Quality; Section 4.3, Cultural Resources; Section 4.6, Livestock Management; Section 4.8, Recreation; Section 4.10, Soils; Section 4.13, Vegetation; and Section 4.16, Wildlife.)

The Proposed Action would generally result in greater impacts to transportation and the transportation system than the No Action Alternative. Transportation requirements under the Proposed Action would result in approximately 4.1 times the number of vehicle trips, traffic volume, and risk of accidents as under the No Action Alternative. Approximately 4.5 times as many miles of new road would be constructed.

4.5.1.2 Alternative B: Reduced Development

4.5.1.2.1 Land Use

Impacts to land use would generally be the same as those described under the Proposed Action (Section 4.5.1.1.1), except that fewer acres of land would be impacted through development under this alternative, as stated in the section above. Under Alternative B, development of 1,114 wells and associated access roads and facilities would result in the disturbance of approximately 5,685 acres during the 15-year construction period. Approximately 79% of the proposed surface disturbance would occur on BLM-administered federal lands. Of the remaining disturbance, approximately 20% would occur on state lands, and approximately 2% would occur on private lands. Table 4-74 summarizes surface disturbance by landowner. Alternative B would result in 3,630 more acres of surface disturbance to all landowners than the No Action Alternative, and would have relatively greater impacts to BLM and private land than to state lands.

4.5.1.2.2 Transportation

Transportation impacts under this alternative would be similar to those described under the Proposed Action (Section 4.5.1.1.2), but would generally be of a lesser magnitude because fewer wells are proposed. Impacts under this alternative would, however, be of a greater magnitude than under the No Action Alternative. Over the course of development under Alternative B, approximately 2,462,115 roundtrips from a range of vehicle types and sizes would be required. A maximum of 375 vehicles per day (110 pickups and 265 large vehicles) would be expected to make roundtrips within the project area during the construction and production phase of the project when vehicles required for construction, completion, and production would all be operating simultaneously (see Figure 4-3). This corresponds to a total of 136,964 visits per year (40,218 pickups and 96,746 large vehicles), and a 4.8% increase over 2009 average daily traffic volume on Highway 40 near Myton, Utah.

Using the same assumptions as the Proposed Action (Section 4.5.1.1.2), the highest volume of traffic proposed would average to one vehicle every 116 seconds during the peak of well construction and production. As stated under the Proposed Action, this estimate may underestimate the minimum interval on major collector roads during the morning and evening if the majority of production traffic uses a limited number of routes; it may overestimate the interval on dispersed rural routes and access roads. The approximately 196,969,193 miles of driving expected under this alternative would increase the risk of traffic accidents accordingly. Using the same conservative assumptions as under the Proposed Action, there would be an increased risk of approximately 2.9 traffic fatalities, 134 accidents with injuries, and 317 property-damaging accidents (without injuries). Alternative B would add approximately 274 miles of new roads within the project area, an increase of 9% over the current 3,000-mile road network (see Table 4-77).

The main arteries used by project traffic would be the same under Alternative B as under the Proposed Action (Table 4-76), but they would carry less traffic. The roads used by recreational and tourist traffic within the project area would also be the same.

Under Alternative B, users of the Nine Mile Canyon Backcountry Byway would experience no project traffic below the rim of Nine Mile Canyon, as defined by Gate Canyon's upper bench and outlined below as encompassing the following three segments (see also Table 4-76):

- Franks Road–Nine Mile Canyon Road to the east of Franks Road
- Nine Mile Canyon Road–From Gate Canyon Road to the west
- Gate Canyon Road/Gate Canyon Upper Bench to Nine Mile Canyon Road

These segments would also not carry any traffic under the No Action Alternative.

As shown in Table 4-76, above Gate Canyon, users would experience progressively more project traffic on the remaining three portions of the Nine Mile Canyon Backcountry Byway. From south to north:

- Gate Canyon Road/Wrinkle Road to Gate Canyon Upper Bench: approximately 3% of project traffic (or a maximum of 11 vehicles per day). This is approximately 11 times as much traffic as would occur on this segment under the No Action Alternative. There is no baseline traffic data for this portion of the Nine Mile Canyon Backcountry Byway against which to compare traffic.
- Wells Draw Road/Sand Wash Road to Wrinkle Road: Approximately 31% of project traffic (or a maximum of 116 vehicles per day). This is approximately 4 to 5 times as much traffic as would occur on this segment under the No Action Alternative. There is no baseline traffic data for this portion of the Nine Mile Canyon Backcountry Byway against which to compare traffic.
- Sand Wash Road/Highway 40 to Wells Draw Road: 100% of project traffic (or a maximum of 375 vehicles per day). This is approximately 4 times as much traffic as would occur on this segment under the No Action Alternative. There is no baseline traffic data for this portion of the Nine Mile Canyon Backcountry Byway against which to compare traffic.

The Sand Wash Road/Highway 40 to Wells Draw Road segment of road would also be traveled by the majority of vehicles traveling to the Sand Wash boat ramp on the Green River. Sand Wash Road users would experience progressively less traffic from this point as they traveled toward the Green River. Between 61% and 69% of project traffic (or a maximum of 244 to 259 vehicles per day) would occur between the Wells Draw Road intersection and the Big Wash Road (the turnoff to Eightmile Flat Road). From 4% to 36% of project traffic (or a maximum of 15 to 135 vehicles per day) would occur between Eightmile Flat Road and Wrinkle Road (see Map 26). This is between 3 and 7 times as much traffic as would occur on these segments under the No Action Alternative. No project traffic would continue past Wrinkle Road toward the Green River.

Impacts to the National Backcountry Byway program designation would be similar to those discussed under the Proposed Action.

Alternative B would generally result in greater impacts to transportation and the transportation system than under the No Action Alternative. Transportation requirements under Alternative B would result in approximately 3.9 times the number of vehicle trips, traffic volume, and increased risk of accidents as under the No Action Alternative. Approximately 3.8 times as many miles of new road would be constructed.

4.5.1.3 ALTERNATIVE C: FULL DEVELOPMENT

4.5.1.3.1 LAND USE

Impacts to land use would generally be the same as those described under the Proposed Action (Section 4.5.1.1.1), except that more acres of land would be impacted through development under this alternative, as stated in the section above. Under Alternative C, development of 1,887 wells and associated access roads and facilities would result in the disturbance of approximately 9,982 acres during the 15-year construction period. Approximately 85% of the proposed surface disturbance would occur on BLM-administered federal lands. Of the remaining disturbance, approximately 14% would occur on state lands, and approximately 1% would occur on private lands. Table 4-74 summarizes surface disturbance by landowner. Alternative C would result in 7,927 more acres of surface disturbance to all landowners than the No Action Alternative, and would have relative greater impacts to BLM (as a percentage of all impacts) than to state lands and private lands.

4.5.1.3.2 TRANSPORTATION

Transportation impacts under this alternative would be similar to those described under the Proposed Action (Section 4.5.1.1.2), but would generally be of a greater magnitude because more wells are proposed. Impacts under this alternative would therefore also be of a greater magnitude than under the No Action Alternative. Over the course of development under Alternative C, approximately 3,231,453 roundtrips would be required in a range of vehicle types and sizes. A maximum of 487 vehicles per day (146 pickups and 341 large vehicles) would be expected to make roundtrips within the project area during the construction and production phase of the project when vehicles required for construction, completion, and production would all be operating simultaneously (see Figure 4-3). This corresponds to a total of 177,833 visits per year (53,286 pickups and 124,547 large vehicles), and a 6.2% increase over 2009 average daily traffic volume on Highway 40 near Myton, Utah.

Using the same assumptions as the Proposed Action (Section 4.5.1.1.2), the highest volume of traffic proposed would average 1 vehicle every 90 seconds during the peak of well construction and production. As stated under the Proposed Action, this estimate may underestimate the minimum interval on major collector roads during the morning and evening if the majority of production traffic uses a limited number of routes; it may overestimate the interval on dispersed rural routes and access roads. The approximately 258,516,203 miles of driving expected under this alternative would increase the risk of traffic accidents accordingly. Using the same conservative assumptions as under the Proposed Action, there would be an increased risk of approximately 3.8 traffic fatalities, 176 accidents with injuries, and 416 property-damaging accidents (without injuries). Alternative C would add approximately 526 miles of new roads within the project area, an increase of 18% over the current 3,000-mile road network (see Table 4-77).

The main arteries used by project traffic would be the same under Alternative C as under the Proposed Action (Table 4-76), but they would carry more traffic. The roads used by recreational and tourist traffic within the project area would also be the same. Under Alternative C, users of the Nine Mile Canyon Backcountry Byway would experience increased traffic below the rim of Nine Mile Canyon, as defined by Gate Canyon's upper bench and outlined below as encompassing the following three segments (see also Table 4-76):

- Franks Road–Nine Mile Canyon Road to the east of Franks Road: approximately 0.1% of project traffic (less than one vehicle per day). This is an increase of 1% over the reported average daily traffic (ADT) at 78 in the upper portions of the Nine Mile Canyon Backcountry Byway.
- Nine Mile Canyon Road–From Gate Canyon Road to the west: approximately 0.6% of project traffic (or a maximum of three vehicle per day). This is an increase of 15% over the reported ADT az 78 in the upper portions of the Nine Mile Canyon Backcountry Byway.
- Gate Canyon Road/Gate Canyon Upper Bench to Nine Mile Canyon Road: approximately 1% of project traffic (or a maximum of five vehicles per day). This is an increase of 23% over the reported ADT of 78 in the upper portions of the Nine Mile Canyon Backcountry Byway.

These three segments would not carry any traffic under the No Action Alternative.

As shown in Table 4-76, above Gate Canyon, users would experience progressively more project traffic on the remaining three portions of the Nine Mile Canyon Backcountry Byway. From south to north:

- Gate Canyon Road/Wrinkle Road to Gate Canyon Upper Bench: approximately 3% of project traffic (or a maximum of 15 vehicles per day). This is approximately 15 times as much traffic as would occur under the No Action Alternative. There is no baseline traffic data for this portion of the Nine Mile Canyon Backcountry Byway against which to compare traffic.
- Wells Draw Road/Sand Wash Road to Wrinkle Road: approximately 36% of project traffic (or a maximum of 175 vehicles per day). This is between 6 and 7 times as much traffic as would occur on this segment under the No Action Alternative. There is no baseline traffic data for this portion of the Nine Mile Canyon Backcountry Byway against which to compare traffic.
- Sand Wash Road/Highway 40 to Wells Draw Road: 100% of project traffic (or a maximum of 487 vehicles per day). This is approximately 5 times as much traffic as would occur on this segment under the No Action Alternative. There is no baseline traffic data for this portion of the Nine Mile Canyon Backcountry Byway against which to compare traffic.

2Impacts to National Backcountry Byway designation would be similar to those discussed under the Proposed Action.

The Sand Wash Road/Highway 40 to Wells Draw Road segment of road would also be traveled by the majority of vehicles traveling to the Sand Wash boat ramp on the Green River. Sand Wash Road users would experience progressively less traffic from this point as they traveled toward the

Green River. Between 58% and 64% of project traffic (or a maximum of 282 to 312 vehicles per day) would occur between the Wells Draw Road intersection and Big Wash Road (the turnoff to Eightmile Flat Road). From 9% to 29% of project traffic (or a maximum of 44 to 141 vehicles per day) would occur between the Eightmile Flat Road and Wrinkle Road (see Map 26). This is between 10 and 11 times as much traffic as would occur on these segments under the No Action Alternative. No project traffic would continue past Wrinkle Road toward the Green River.

Alternative C would generally result in greater impacts to transportation and the transportation system than the No Action Alternative. Transportation requirements under Alternative C would result in approximately 5.1 times the number of vehicle trips, traffic volume, and increased risk of accidents as under the No Action Alternative. Approximately 7.3 times as many miles of new road would be constructed.

4.5.1.4 ALTERNATIVE D: NO ACTION

4.5.1.4.1 LAND USE

Impacts to land use would generally be the same as those described under the Proposed Action (Section 4.5.1.1.1), except that fewer acres of land would be impacted through development under this alternative, as stated in the section above. Under the No Action Alternative, development of 368 wells and associated access roads and facilities would result in the disturbance of approximately 2,055 acres during the 15-year construction period. Approximately 75% of the proposed surface disturbance would occur on BLM-administered federal lands. Of the remaining disturbance, approximately 24% would occur on state lands, and approximately 1% would occur on private lands. Table 4-74 summarizes surface disturbance by landowner. The No Action Alternative would result in the least surface disturbance to property owners in the project area of any alternative.

4.5.1.4.2 TRANSPORTATION

Transportation impacts under this alternative would be similar to those described under the Proposed Action (Section 4.5.1.1.2), but would generally be of a far lesser magnitude because far fewer wells are anticipated. Over the 45-year course of development and production under the No Action Alternative, approximately 630,193 roundtrips would be required in a range of vehicle types and sizes. A maximum of 95 vehicles per day (28 pickups and 67 large vehicles) would be expected to make roundtrips within the project area during the construction and production phase of the project when vehicles required for construction, completion, and production would all be operating simultaneously (see Figure 4-3). This corresponds to a total of 34,681 visits per year (10,392 pickups and 24,289 large vehicles), and a 1.2% increase over 2009 average daily traffic volume on Highway 40 near Myton, Utah.

Using the same assumptions as the Proposed Action (Section 4.5.1.1.2), the highest volume of traffic proposed would average 1 vehicle every 460 seconds (7 minutes 40 seconds) during the peak of well construction and production. As stated under the Proposed Action, this estimate may underestimate the minimum interval on major collector roads during the morning and evening if the majority of production traffic uses a limited number of routes; it may overestimate the interval on dispersed rural routes and access roads. The approximately 50,415,455 miles of driving expected under this alternative would increase the risk of traffic accidents accordingly. Using the same conservative assumptions as under the Proposed Action, there would be an increased risk of approximately 0.7 traffic fatalities, 34 accidents with injuries, and 81 property-damaging accidents (without injuries) over the life of the project. The No Action Alternative would add approximately 72 miles of new roads within the project area, an increase of 2% over the current 3,000-mile road network (see Table 4-67).

The main arteries used by project traffic would be the same under the No Action Alternative as under the Proposed Action (Table 4-76), but they would carry less traffic. The roads used by recreational and tourist traffic within the project area would also be the same. Under the No Action Alternative, users of the Nine Mile Canyon Backcountry Byway would experience no project traffic below the rim of Nine Mile Canyon, as defined by Gate Canyon's upper bench and outlined below as encompassing the following three segments (see also Table 4-76):

- Franks Road–Nine Mile Canyon Road to the east of Franks Road
- Nine Mile Canyon Road–From Gate Canyon Road to the west
- Gate Canyon Road/Gate Canyon Upper Bench to Nine Mile Canyon Road

As shown in Table 4-76, above Gate Canyon, users would experience progressively more project traffic on the remaining three portions of the Nine Mile Canyon Backcountry Byway. From south to north:

- Gate Canyon Road/Wrinkle Road to Gate Canyon Upper Bench: approximately 1% of project traffic (or a maximum of one vehicle per day). There is no baseline traffic data for this portion of the Nine Mile Canyon Backcountry Byway against which to compare traffic.
- Wells Draw Road/Sand Wash Road to Wrinkle Road: approximately 27% of project traffic (or a maximum of 26 vehicles per day). There is no baseline traffic data for this portion of the Nine Mile Canyon Backcountry Byway against which to compare traffic.
- Sand Wash Road/Highway 40 to Wells Draw Road: 100% of project traffic (or a maximum of 95 vehicles per day). There is no baseline traffic data for this portion of the Nine Mile Canyon Backcountry Byway against which to compare traffic.

Impacts to the National Backcountry Byway program designation would be similar to those discussed under the Proposed Action.

The Sand Wash Road/Highway 40 to Wells Draw Road segment of road would also be traveled by the majority of vehicles traveling to the Sand Wash boat ramp on the Green River. Sand Wash Road users would experience progressively less traffic from this point as they traveled toward the Green River. Approximately 65% to 73% of project traffic, or a maximum of 62-69 vehicles per day would occur between the Wells Draw Road intersection and Big Wash Road (the turnoff to Eightmile Flat Road). From 4% to 15% of project traffic, or a maximum of 4 to 14 vehicles per day would occur between the Eightmile Flat Road and Wrinkle Road (see Map 26). No project traffic would continue past Wrinkle Road toward the Green River.

4.5.1.5 Alternative E: Reduced Development with Directional Drilling

4.5.1.5.1 Land Use

Impacts to land use would generally be the same as those described under the Proposed Action (Section 4.5.1.1.1), except that fewer acres of land would be impacted through development under this alternative, as stated in the section above. Under Alternative E, development of 1,114 wells and associated access roads and facilities would result in the disturbance of approximately 2,174 acres during the 15-year construction period. Approximately 80% of the proposed surface disturbance would occur on BLM-administered federal lands. Of the remaining disturbance, approximately 18% would occur on state lands, and approximately 2% would occur on private lands. Table 4-74 summarizes surface disturbance by landowner. Alternative E would result in 119 more acres of surface disturbance to all landowners than the No Action Alternative, and would have relatively greater impacts to BLM and private land than to state lands.

4.5.1.5.2 Transportation

Transportation impacts under this alternative would be similar to those described under the Proposed Action (Section 4.5.1.1.2), but would generally be of a lesser magnitude because fewer wells are proposed. Impacts under this alternative would, however, be of a greater magnitude than under the No Action Alternative. Over the course of development under Alternative E, approximately 2,435,040 roundtrips from a range of vehicle types and sizes would be required. A maximum of 372 vehicles per day (108 pickups and 264 large vehicles) would be expected to make roundtrips within the project area during the construction and production phase of the project when vehicles required for construction, completion, and production would all be operating simultaneously (see Figure 4-3). This corresponds to a total of 135,941 visits per year (39,546 pickups and 96,395 large vehicles), and a 4.8% increase over 2009 average daily traffic volume on Highway 40 near Myton, Utah.

Using the same assumptions as the Proposed Action (Section 4.5.1.1.2), the highest volume of traffic proposed would average to one vehicle every 117 seconds during the peak of well construction and production. As stated under the Proposed Action, this estimate may underestimate the minimum interval on major collector roads during the morning and evening if the majority of production traffic uses a limited number of routes; it may overestimate the interval on dispersed rural routes and access roads. The approximately 194,803,193 miles of driving expected under this alternative would increase the risk of traffic accidents accordingly. Using the same conservative assumptions as under the Proposed Action, there would be an increased risk of approximately 2.9 traffic fatalities, 132 accidents with injuries, and 314 property-damaging accidents (without injuries). Alternative E would add approximately 106 miles of new roads within the project area, an increase of 4% over the current 3,000-mile road network (see Table 4-77).

The impacts to main transportation arteries and roads used by recreational and tourist traffic under Alternative E would be nearly the same as under Alternative B, including impacts to each of the six segments of the Nine Mile Canyon Backcountry Byway. Approximately 1.4% fewer vehicle trips would be required on all road segments due to the slightly fewer vehicles required for well pad construction and reclamation. Transportation requirements under Alternative E would result in approximately 3.9 times the number of vehicle trips, traffic volume, and increased risk of accidents as under the No Action Alternative. Approximately 1.5 times as many miles of new road would be constructed (primarily well-pad access roads) as under the No Action Alternative.

Impacts to the National Backcountry Byway program designation would be similar to those discussed under the Proposed Action.

4.5.1.6 ALTERNATIVE F: AGENCY PREFERRED ALTERNATIVE

4.5.1.6.1 LAND USE

Impacts to land use would generally be the same as those described under the Proposed Action (Section 4.5.1.1.1), except that fewer acres of land would be impacted through development than under the Proposed Action. Under Alternative F, development of 1,298 wells and associated access roads and facilities would result in the disturbance of approximately 3,602 acres during the 15-year construction period. Approximately 83% of the proposed surface disturbance would occur on BLM-administered federal lands. Of the remaining disturbance, approximately 16% would occur on state lands, and approximately 1% would occur on private lands. Table 4-74 summarizes surface disturbance by landowner. Alternative F would result in 1,547 more acres of surface disturbance to all landowners than the No Action Alternative, and would have relatively greater impacts to BLM and state land than to private lands.

4.5.1.6.2 TRANSPORTATION

Transportation impacts under this alternative would be similar to those described under the Proposed Action (Section 4.5.1.1.2), but would generally be of a lesser magnitude because fewer wells are proposed. Impacts under this alternative would, however, be of a greater magnitude than under the No Action Alternative. Over the course of development under Alternative F, approximately 2,178,499 roundtrips from a range of vehicle types and sizes would be required. A maximum of 351 vehicles per day (104 pickups and 247 large vehicles) would be expected to make roundtrips within the project area during the construction and production phase of the project when vehicles required for construction, completion, and production would all be operating simultaneously (see Figure 4-3). This corresponds to a total of 128,148 visits per year (37,976 pickups and 90,172 large vehicles), and a 4.5% increase over 2009 average daily traffic volume on Highway 40 near Myton, Utah.

Using the same assumptions as the Proposed Action (Section 4.5.1.1.2), the highest volume of traffic proposed would average one vehicle every 123 seconds during the peak of well construction and production. As stated under the Proposed Action, this estimate may underestimate the minimum interval on major collector roads during the morning and evening if the majority of production traffic uses a limited number of routes; it may overestimate the interval on dispersed rural routes and access roads. The approximately 174,279,919 miles of driving expected under this alternative would increase the risk of traffic accidents accordingly. Using the same conservative assumptions as under the Proposed Action, there would be an increased risk of approximately 2.6 traffic fatalities, 119 accidents with injuries, and 281 property-damaging accidents (without injuries). Alternative F would add approximately 198 miles of new roads within the project area, an increase of 7% over the current 3,000-mile road network (see Table 4-67).

The main arteries used by project traffic would be the same under Alternative F as under the Proposed Action (Table 4-76), but they would carry less traffic. The roads used by recreational and tourist traffic within the project area would also be the same. Under Alternative F, users of the Nine Mile Canyon Backcountry Byway would experience no project traffic below the rim of Nine Mile Canyon, as defined by Gate Canyon's upper bench and outlined below as encompassing the following three segments (see also Table 4-76):

- Franks Road–Nine Mile Canyon Road to the east of Franks Road
- Nine Mile Canyon Road–From Gate Canyon Road to the west
- Gate Canyon Road/Gate Canyon Upper Bench to Nine Mile Canyon Road

As shown in Table 4-76, above Gate Canyon, users would experience progressively more project traffic on the remaining three portions of the Nine Mile Canyon Backcountry Byway. From south to north:

- Gate Canyon Road/Wrinkle Road to Gate Canyon Upper Bench: Approximately 3% of project traffic (or a maximum of 11 vehicles per day). This is approximately 11 times as much as compared to the No Action Alternative. There is no baseline traffic data for this portion of the Nine Mile Canyon Backcountry Byway against which to compare traffic.
- Wells Draw Road/Sand Wash Road to Wrinkle Road: Approximately 33% of project traffic (or a maximum of 116 vehicles per day). This is between 4 and 5 times as much traffic as would occur on this segment under the No Action Alternative. There is no baseline traffic data for this portion of the Nine Mile Canyon Backcountry Byway against which to compare traffic.
- Sand Wash Road/Highway 40 to Wells Draw Road: 100% of project traffic (or a maximum of 351 vehicles per day). This is between 3 and 4 times as much traffic as would occur on this segment under the No Action Alternative. There is no baseline traffic data for this portion of the Nine Mile Canyon Backcountry Byway against which to compare traffic.

Impacts to the National Backcountry Byway program designation would be similar to those discussed under the Proposed Action.

The Sand Wash Road/Highway 40 to Wells Draw Road segment of road would also be traveled by the majority of vehicles traveling to the Sand Wash boat ramp on the Green River. Sand Wash Road users would experience progressively less traffic from this point as they traveled toward the Green River. Approximately 63% to 67% of project traffic, or a maximum of 221 to 235 vehicles per day would occur between the Wells Draw Road intersection and Big Wash Road (the turnoff to Eightmile Flat Road). From 8% to 41% of project traffic, or a maximum of 28 to 144 vehicles per day would occur between the Eightmile Flat Road and Wrinkle Road (see Map 26). No project traffic would continue past Wrinkle Road toward the Green River.

Alternative F would generally result in greater impacts to transportation and the transportation system than under the No Action Alternative. Transportation requirements under Alternative F would result in approximately 3.5 times the number of vehicle trips, 3.7 times the traffic volume, and 3.5 times the increased risk of accidents as under the No Action Alternative. Approximately 2.75 times as many miles of new road would be constructed (primarily well-pad access roads) as under the No Action Alternative.

4.5.2 MITIGATION

4.5.2.1 LAND USE MITIGATION

Potential conflicts with existing ROWs could be resolved on a site-specific basis, including the use of applicable Fluid Minerals BMPs from Appendix R of the Vernal RMP (BLM 2008c).

4.5.2.2 TRANSPORTATION MITIGATION

Proposed mitigation measures that could be applied to reduce the impacts to transportation include the following:

- Gasco would implement speed limits for their employees and contractors while driving roads within the project area, as well as require adherence to speed limits beyond the project area.
- Additional permanent and temporary signage would be placed alerting motorists to upcoming construction vehicles in order to lower the probability of accidents.
- Gasco would coordinate with the appropriate authorizing officer (AO) when construction, maintaining, or reclaiming roads.
- Cooperative road management plans would be developed between Gasco, Duchesne County, Uintah County, the State of Utah, and private landowners to address maintenance requirements and responsibilities, and to ensure that roads used by project vehicles are not degraded.
- Whenever practicable, heavy and/or slow-moving equipment would be moved at night or during non-peak driving times to minimize delays to other users. Flaggers and/or flag cars would be used to alert non-project traffic to upcoming project equipment.
- Gas and water pipelines would be buried at road crossings.
- Signs would be installed in areas of heavy equipment and truck traffic for warning other users.
- Passing areas would be constructed as directed by the AO so other users can safely pass project-related vehicles.
- Road disturbances in areas with soils susceptible to wind erosion would be surfaced (graveling, water, or surfactants applied to roads, etc.) as directed by the AO to reduce fugitive dust generated by traffic and related activities.
- As feasible in order to reduce vehicle trips, Operator would use centralized tank locations for water and condensate tanks. The feasibility of centralizing tank facilities would be determined on a site-specific basis.
- Gasco would bury all pipelines crossing County roads to a minimum depth of 5 feet to ensure the safety of road maintenance workers and activities.
- All applicable Fluid Minerals BMPs from Appendix R of the Vernal RMP (BLM 2008c) would be implemented, including seasonal restrictions on vehicular access where there are wildlife conflict or road damage/maintenance issues.

4.5.3 UNAVOIDABLE ADVERSE IMPACTS

Increased vehicular traffic would increase local traffic volumes, increase the risk of traffic accidents, increase the local requirements for road maintenance, and cause occasional delays for non-project users. Although the risk of traffic accidents, delays, and the need for increased road maintenance could be mitigated (see Mitigation, above), there would still be some residual impacts.

4.5.4 IRRETRIEVABLE AND IRREVERSIBLE COMMITMENTS OF RESOURCES

Surface disturbance by the project would remain in that state until rehabilitated (approximately 30 years after drilling, or until approximately 2053), as described elsewhere in this chapter. Any traffic accidents caused by project-related activities would be irreversible.

4.5.5 RELATIONSHIP OF SHORT-TERM USES TO LONG-TERM PRODUCTIVITY

This project is unlikely to impact long-term land use, land ownership, or land management. The increased road network required for the project would lead to increased access over the lifetime of the project, or until project roads were decommissioned. Although increased traffic volume from drilling and construction would occur for 15 years, it would be a short-term impact in any given location due to its localized nature. Traffic volume increases during production would be less than during the combined drilling and production phase, but would persist for the life of the project.

4.6 LIVESTOCK MANAGEMENT

Impacts to livestock are anticipated under each of the alternatives. Potential adverse direct impacts to livestock include the loss of forage and an increased risk of vehicular collisions with animals. Indirect effects include noxious weed invasion. The proposed well development would result in both a short- and long-term loss of available livestock forage, with the amount timing of long-term loss dependent upon reclamation success.

The primary loss to livestock from Alternative A (Proposed Action) is the amount of available forage in terms of animal unit months (AUMs). Loss of forage impacts to livestock are measured by calculating the potential loss of AUMs (due to clearing vegetation) resulting from construction of wells, roads, pipelines, and evaporative ponds. AUMs are a measure of vegetation quantity and do not necessarily reflect the number of grazing permits allotted in the project area. AUMs are a measure of the amount of food necessary to feed a cow and her calf for 1 month.

Impacts to livestock are also anticipated from an increased risk of livestock collisions measured by the proportional changes in miles of roads in the project area under each alternative. Additionally, there is an increased risk of noxious weed invasions and increased potential for entrained dust resulting from the proportional changes in acres of vegetation disturbed under each alternative.

4.6.1 DIRECT AND INDIRECT EFFECTS

4.6.1.1 ALTERNATIVE A: PROPOSED ACTION

Project-related development (including evaporative ponds) throughout the project area would result in loss of vegetation, thereby reducing the amount of forage available for livestock. The following table illustrates the total acres of disturbance and the percentage of allotments that would be affected by the Proposed Action.

Table 4-78. Acres of Vegetation Impacted by Alternative

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Acres of disturbance[1]	7,536	5,643	9,956	2,034	2,158	3,601
Percentage of total allotments within project area*	3.7%	2.8%	4.9%	1.0%	1.1%	1.8%

*The total acreage of allotments that fall in the project area is 204,713.

[1]This figure includes acreage of vegetation removal in the stock drive trail.

Impacts to AUMs from the Proposed Action were calculated by multiplying the total AUMs allocated to livestock by the percentage of the allotment that would be directly impacted by surface-disturbing activities under the Proposed Action. Table 4-79 shows the number of AUMs that would be impacted within each grazing allotment, as well as the overall percentage that those AUMs represent for the entire allotment. Across all allotments, AUM loss averages approximately 1 AUM per 10 acres of surface disturbance.

As shown in the table, the Proposed Action would impact a total of 740 AUMs, which is 1.6% of the total adjudicated AUMs available in all of the allotments (46,048 AUMs) and total allotment acreage, and 3.7% of the allotment and livestock use within the Gasco project area. The overall impacts are such that the Proposed Action would have greater impacts (740 AUMs) to grazing than Alternative B (554 AUMs), the No Action Alternative (200 AUMs), Alternative E (219 AUMs), and Alternative F (369 AUMs), but fewer than Alternative C (972 AUMs).

In addition to impacts to grazing from decreased AUMs, there is an increased potential for livestock collisions as a result of well development. Although it is not possible to calculate the exact collisions that would occur per mile, it can be assumed that the more miles of roads that are constructed, the increased risk of collision. The following list shows the miles of roads that would be constructed under each alternative:

- Proposed Action: 325 miles
- Alternative B: 274 miles
- Alternative C: 526 miles
- No Action Alternative: 72 miles
- Alternative E: 106 miles
- Alternative F: 198 miles

Indirect effects resulting from the spread of noxious weeds would adversely impact livestock because they cannot use these species for forage. Because the spread of noxious weeds is often related to road construction, the above list of road mileage for analysis of livestock collisions can also be used to compare impacts between the alternatives for increased noxious weeds invasion. Similar analysis can be used in that the more miles proposed for well development, the greater the risk for noxious weeds to spread. Additionally, impacts to vegetation resulting from project construction may result in increased dust on vegetation, which can also reduce available forage. For impacts to vegetation resulting from project construction, please refer to the vegetation acreages listed in Table 4-78.

Compared to the No Action Alternative, the Proposed Action would impact approximately 4 times the number of AUMs and would propose 253 more miles of roads (450%) for well development resulting in greater impacts. The Proposed Action would also impact 25 acres of the stock drive trail, approximately 250% more acreage than the No Action Alternative.

Table 4-79. Forage Lost (AUMs) in the Project Area by Allotment*

Grazing Allotment and AUMS Available		Alternative A (Proposed Action)			Alternative B (Reduced)			Alternative C (Full)			Alternative D (No Action)			Alternative E (Directional)			Alternative F (Agency Preferred)		
Allotment Name	Total Allotment Acreage	Acres of Allotment	Percentage of Allotment	AUMs Impacted under A	Acres of Allotment	Percentage of Allotment	AUMs Impacted under B	Acres of Allotment	Percentage of Allotment	AUMs Impacted under C	Acres of Allotment	Percentage of Allotment	AUMs Impacted under D	Acres of Allotment	Percentage of Allotment	AUMs Impacted under E	Acres of Allotment	Percentage of Allotment	AUMs Impacted under F
Antelope Powers	40,466	22	0.1%	2	22	0.1%	2	190	0.5%	21	65	0.2%	7	1	0.0%	0	17	0.0%	2
Big Wash	5,367	162	3.0%	30	161	3.0%	29	334	6.2%	61	32	0.6%	6	56	1.0%	10	108	2.0%	20
Big Wash Draw	8,372	109	1.3%	7	109	1.3%	7	373	4.5%	23	62	0.7%	4	46	0.5%	3	71	0.8%	4
Bull Canyon	16,578	169	1.0%	10	103	0.6%	6	570	3.4%	34	32	0.2%	2	41	0.2%	2	121	0.7%	7
Castle Peak	51,824	928	1.8%	85	830	1.6%	76	1,883	3.6%	173	598	1.2%	55	303	0.6%	28	389	0.8%	36
Currant Canyon	6,975	39	0.6%	2	19	0.3%	1	76	1.1%	5	0	0.0%	0	0	0.0%	0	18	0.3%	1
Devils Canyon	22,351	661	3.0%	80	231	1.0%	28	618	2.8%	75	74	0.3%	9	93	0.4%	11	424	1.9%	52
Eightmile Flat	27,550	343	1.2%	53	270	1.0%	42	552	2.0%	85	170	0.6%	26	206	0.7%	32	138	0.5%	21
Five Mile	15,622	634	4.1%	88	614	3.9%	85	790	5.1%	109	92	0.6%	13	240	1.5%	33	426	2.7%	59
Green River	139,485	0	0.0%	0	0	0.0%	0	44	0.0%	0	0	0.0%	0	0	0.0%	0	0	0.0%	0
Green River allotment management plan (AMP)	9,608	0	0.0%	0	0	0.0%	0	0	0.0%	0	0	0.0%	0	0	0.0%	0	0	0.0%	0
Green River Bottoms	7,159	33	0.5%	2	33	0.5%	2	55	0.8%	4	1	0.0%	0	14	0.2%	1	3	0.0%	0
Little Desert	49,361	2657	5.4%	205	2,100	4.3%	162	2,648	5.4%	204	516	1.0%	40	746	1.5%	57	1126	2.3%	87
Max Canyon	365	0	0.0%	0	0	0.0%	0	0	0.0%	0	0	0.0%	0	0	0.0%	0	0	0.0%	0
Stone Canyon	30,463	0	0.0%	0	0	0.0%	0	2	0.0%	0	0	0.0%	0	0	0.0%	0	0	0.0%	0
Twin Knolls	6,969	417	6.0%	59	227	3.3%	32	326	4.7%	46	46	0.7%	7	87	1.2%	12	263	3.8%	37
Water Canyon 2	6,698	324	4.8%	18	259	3.9%	14	289	4.3%	16	38	0.6%	2	94	1.4%	5	184	2.8%	10
Wells Draw	10,923	316	2.9%	35	317	2.9%	35	423	3.9%	47	111	1.0%	12	126	1.2%	14	207	1.9%	23
Wetlands	18,481	697	3.8%	63	347	1.9%	31	757	4.1%	68	189	1.0%	17	103	0.6%	9	104	0.6%	9
Total	**474,617**	**7511**	**1.6%**	**740**	**5,642**	**1.2%**	**554**	**9,930**	**2.1%**	**972**	**2,026**	**0.4%**	**200**	**2,156**	**0.5%**	**219**	**3,600**	**0.8%**	**369**

* Total acreage does not include the stock drive trail acreage, which has no allotted AUMs.

4.6.1.2 Alternative B: Reduced Development

Alternative B would result in the direct removal of 5,643 acres of vegetation. Alternative B would impact a total of 554 AUMs, which is 1.2% of the total adjudicated AUMs available in all of the allotments (46,048 AUMs) and total allotment acreage, and 2.8% of the allotment/livestock use acreage within the Gasco project area. Alternative B also proposes 274 miles of roads for well development. This is approximately 3 times the number of AUMs and approximately 4 times more miles of roads than under the No Action Alternative. Alternative B would therefore result in greater impacts. Alternative B would impact less than one-half acre of the stock drive trail, approximately 4% of the 9.67 acres that would be impacted under the No Action Alternative.

4.6.1.3 Alternative C: Full Development

Alternative C would result in the direct removal of 9,956 acres of vegetation. Alternative C would impact a total of 972 AUMs, which is 2.1% of the total adjudicated AUMs available in all of the allotments and total allotment acreage, and 4.9% of the allotment/livestock use acreage within the Gasco project area. Alternative C also proposes 274 miles of roads for well development. This is approximately 5 times more impact to AUMs and 7.3 times the number of roads miles than proposed under the No Action Alternative. Alternative C would also impact 27 acres of the stock drive trail, approximately 280% more acreage than the No Action Alternative.

4.6.1.4 Alternative D: No Action

The No Action Alternative would result in the direct removal of 2,034 acres of vegetation. The No Action Alternative would impact a total of 200 AUMs, which is 0.4% of the total adjudicated AUMs available in all of the allotments and total allotment acreage, and 1.0% of the allotment/livestock use acreage within the Gasco project area (including impacts to 9.67 acres of the stock drive trail). The No Action Alternative proposes 72 miles of roads for well development. This would result in the least amount of impact to livestock of all the alternatives.

4.6.1.5 Alternative E: Reduced Development with Directional Drilling

Alternative E would result in the direct removal of 2,158 acres of vegetation. Alternative E would impact a total of 200 AUMs, which is 0.5% of the total adjudicated AUMs available in all of the allotments (46,048 AUMs) and total allotment acreage, and 1.1% of the allotment/livestock use acreage within the Gasco project area. Alternative E also proposes 106 miles of roads for well development. Alternative E would therefore result in greater impacts than the No Action Alternative. Alternative E would impact approximately 1.2 acres of the stock drive trail, approximately 12% of the 9.67 acres that would be impacted under the No Action Alternative.

4.6.1.6 Alternative F: Agency Preferred Alternative

Alternative F would result in the direct removal of 3,601 acres of vegetation. Alternative F would impact a total of 369 AUMs, which is 0.8% of the total adjudicated AUMs available in all of the allotments and total allotment acreage, and 1.1% of the allotment/livestock use acreage within the Gasco project area. Alternative F also proposes 198 miles of roads for well development. Alternative F would therefore result in greater impacts than the No Action Alternative. Alternative F would impact approximately 1.5 acres of the stock drive trail, approximately 15% of the 9.67 acres that would be impacted under the No Action Alternative.

4.6.2 MITIGATION

Applicable Fluid Minerals BMPs from Appendix R of the Vernal RMP (BLM 2008c) would be used to reduce impacts to livestock forage and/or operation and facilities.

4.6.3 UNAVOIDABLE ADVERSE IMPACTS

Removal of vegetation as a result of construction and project development would occur under all of the alternatives. Thus, reduction in forage in several allotments would occur under each of the alternatives. Also as a result of construction, there would be an unavoidable increase in risk of livestock disturbance and collision.

4.6.4 IRRETRIEVABLE AND IRREVERSIBLE COMMITMENTS OF RESOURCES

Irretrievable impacts would include the potential loss of livestock forage for several years until reclamation is successful. Irreversible impacts would include areas with permanently removed vegetation and livestock mortality, should any occur.

4.6.5 RELATIONSHIP OF SHORT-TERM USES TO LONG-TERM PRODUCTIVITY

Activities associated with the proposed oil and gas well development (e.g., roads, grading, vegetation removal), would reduce the forage productivity and available AUMs until the disturbances were successfully reclaimed. Overall, impacts to long-term productivity resulting from these activities would be minimal due to the limited overall percentages that would be impacted by the Proposed Action.

4.7 PALEONTOLOGICAL RESOURCES

The loss of any identifiable fossil that embodies the distinctive characteristics of a type of prehistoric organism, or provides information regarding prehistory, would be an adverse environmental impact. Direct impacts on paleontological resources would include the potential destruction of paleontological resources and the loss of information associated with these resources. If potentially fossiliferous bedrock or surface sediments are disturbed, project excavations may result in the destruction of paleontological resources and subsequent loss of information. The unlawful collection of vertebrate fossils would also be an adverse impact. Conversely, construction activities might beneficially impact paleontological resources if fossils are exposed that may never have been unearthed by natural means. When mitigation measures are implemented, these newly exposed fossils would become available for salvage, scientific analysis, and preservation at a public museum. In this way, direct adverse impacts could be reversed into beneficial impacts through the proper implementation of a paleontological monitoring and mitigation program.

Indirect impacts occur later in time or farther away in distance than direct impacts. Adverse indirect impacts would include the compaction or fracturing of surface deposits or fossiliferous bedrock through daily operation of project activities. Another example of a possible adverse indirect impact would be an increase in unauthorized fossil collection or vandalism due to increased access on new, project-related roads.

In general, for project sites that contain paleontologically sensitive geologic units (such as the Green River or Uinta formations), the greater the degree of construction-related ground disturbance, the higher the potential for adverse impacts on paleontological resources. Potential adverse impacts on paleontological resources include direct impacts related to construction of wells, evaporative ponds, and roads, as well as indirect impacts related to the operations of such facilities.

The nature of potential impacts on paleontological resources would be the same under all alternatives. However, the extent of impacts would vary by alternative based on the amount of surface disturbance that would occur on *Condition 1* and *3* and Potential Fossil Yield Classification (PFYC) system *Class 2* and *5* lands (see Section 4.7.1.1), as well as the extent in miles of new roads in the project area allowing for increased access (see Section 4.7.1.1). The general nature of potential impacts common to all alternatives is discussed under the Proposed Action. Impacts related to the Proposed Action and Alternatives B, C, E, and F are compared to the No Action Alternative.

4.7.1 Direct and Indirect Effects

4.7.1.1 Alternative A: Proposed Action

Within the project area, potential direct adverse impacts on paleontological resources are most likely to occur where bedrock strata of the Green River and Uinta formations are disturbed by construction. This would include grading for natural gas well pads, access roads, compressor stations, and construction lay-down areas, as well as ground disturbances caused by brushing, grading, trenching, or boring for pipelines. It would also include augering for piles, poles, or electrical towers, as well as surface impacts associated with geophysical investigations and evaporative ponds. These activities (and any other ground-disturbing actions) have the potential to adversely impact an unknown quantity of fossils that may occur on or underneath the surface in areas containing paleontologically sensitive geologic units. Without mitigation, these fossils would be adversely impacted (destroyed).

Paleontological resources can only provide high-quality data when they are recovered directly from the rock layer in which they were preserved. In most cases, the depth and lateral extent of fossiliferous deposits are unknown until they are discovered either by chance or as the result of systematic testing by paleontologists. The fossils can then be excavated, and associated data can be recovered, followed by transportation to a public museum for laboratory preparation, analysis, and permanent storage to make them available for scientific research, education, and display. Even if the depth and extent of project-related surface-disturbing activities was known, precise impacts could not be calculated. Therefore, any analysis of the potential impacts of a ground-disturbing project on paleontological resources must rely on data that estimate the potential for sensitivity of particular geologic units based on the frequency and density of past discoveries.

As stated in Section 3.7 (Paleontological Resources), the BLM is currently transitioning between 2 different classification systems, the General Procedural Guidance for Paleontological Resource Management, and the PFYC system. Both systems will be used in this analysis.

Under the BLM Paleontological Resource Classification System, four geologic units found within the project area are considered paleontologically highly sensitive: the Uinta Formation, the Green River Formation, River Terrace Deposits, and Older Pediment Deposits. The Uinta

Formation and Parachute Creek Member of the Green River Formation are both classified as *Condition 1* using the BLM's Paleontological Resource Classification System, which includes "areas that are known to contain vertebrate fossils or noteworthy occurrences of invertebrate of plant fossils." The River Terrace and Older Pediment Deposits, and the members and subunits of the Green River Formation (excluding the Parachute Creek Member) are classified as *Condition 3* and "are very unlikely to produce vertebrate fossils or noteworthy occurrences of invertebrate or plant fossils."

Under the PFYC system, the members and subunits of the River Terrace and Older Pediment Deposits are designated as *Class 2* ("not likely to contain vertebrate fossils or scientifically significant nonvertebrate fossils"), and the Uinta Formation and Parachute Creek Member of the Green River Formation are considered *Class 5* ("highly fossiliferous geologic units that regularly and predictably produce vertebrate fossils or uncommon invertebrate or plant fossils"). Refer to Section 3.7 (Paleontological Resources) for detailed explanations of these classifications.

Under the BLM classification system, approximately 189,364 acres of land in the project area are *Condition 1*, and 17,463 acres are *Condition 3* (see Map 12). Fossils are more likely to occur in *Condition 1* areas, because paleontological resources are unlikely to occur in *Condition 3* lands. Where project-related ground disturbance occurs on *Condition 1* and *3* lands, there is a potential for direct adverse impacts due to the breakage and crushing of fossils associated with construction. Under the Proposed Action, approximately 6,906 acres (3.6%) of *Condition 1* areas and 678 acres (3.9%) of *Condition 3* areas would be disturbed. This is approximately 4 times the disturbance in *Condition 1* areas and approximately twice the disturbance in *Condition 3* areas than under the No Action Alternative (Table 4-80).

Table 4-80. Acreage and Percentage of Land Disturbance by Alternative in Condition Class and PFYC-classified Areas with High Potential to Yield Fossils

	Total Acres in Project Area	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Condition Classification							
Condition 1	189,364	6,906 (3.6%)	5,213 (2.8%)	8,911 (4.7%)	1,748 (0.9%)	1,902 (1.0%)	3,367 (1.8%)
Condition 3	17,463	678 (3.9%)	472 (2.7%)	1,067 (6.1%)	308 (1.8%)	272 (1.6%)	234 (1.3%)
Totals	**206,827**	**7,584 (3.7%)**	**5,685 (2.8%)**	**9,978 (4.8%)**	**2,056 (1.0%)**	**2,174 (1.0%)**	**3,601 (1.7%)**
PFYC							
Class 2	17,463	678 (3.9%)	472 (2.7%)	1,067 (6.1%)	308 (1.8%)	272 (1.6%)	234 (1.3%)
Class 5	189,364	6,906 (3.6%)	5,213 (2.8%)	8,911 (4.7%)	1,748 (0.9%)	1,902 (1.0%)	3,367 (1.8%)
Totals	206,827	7,584 (3.7%)	5,685 (2.8%)	9,978 (4.8%)	2,056 (1.0%)	2,174 (1.0%)	3,601 (1.7%)

Under the PFYC system, approximately 17,463 acres in the project area are *Class 2*, and 189,364 acres are *Class 5* (see Map 13). Where project-related ground disturbance occurs in *Class 2* and *Class 5* geologic units, there is a potential for direct adverse impacts due to the breakage and crushing of fossils associated with construction. Under the Proposed Action, ground disturbance would occur on approximately 678 acres (3.9%) of *Class 2* geologic units, and 6,906 acres (3.6%) of *Class 5* geologic units. This is approximately twice the disturbance in *Class 2* geologic units and approximately 4 times the disturbance in *Class 5* geologic units than under the No Action Alternative (see Table 4-80).

If paleontological monitoring and mitigation procedures are properly implemented, it is likely that potential adverse impacts would be converted to potential beneficial impacts. First, a field survey for surface fossils would be conducted prior to ground-disturbing activities. This would allow for the opportunity to recover any fossils found before ground disturbance occurs. In the event that a potentially significant fossil was uncovered during construction, work would temporarily stop in that area while qualified and BLM-permitted paleontologists excavated, recorded, and removed the discovery from the site for permanent preservation in a museum. Therefore, the proposed 7,584 acres (3.7%) of disturbance within *Condition Class 1* and *3* areas and PFYC *Class 2* and *5* geologic units could also be considered a potential beneficial impact on paleontological resources. Under the No Action Alternative, 73% less disturbance within *Condition Class 1* and *3* areas and PFYC *Class 2* and *5* areas would occur, resulting in fewer beneficial impacts to paleontological resources than under the Proposed Action. Any scientifically significant fossils discovered and salvaged as a result of the project's surface-disturbing activities would benefit the scientific community through an increase in knowledge associated with the fossils.

The potential for indirect adverse impacts to paleontological resources as a result of the Proposed Action is low. Daily operations for this project would include pumping natural gas from wells, repairing wells when necessary, and making associated vehicle trips on project roads. Operations and maintenance activities would not be expected to impact paleontological resources, because most surface disturbance would have been confined to the construction period.

A second category of possible indirect adverse impacts would include a greater risk of illegal fossil collection due to the increased access provided by project-related roads. The Uinta Basin is well known among the public for its fossil deposits, and fossil collecting is a common activity in the area. Under the Proposed Action, 325 miles of new roads would be constructed in the project area, increasing the risk of illegal fossil collection there compared to the No Action Alternative, which would result in 72 miles of new roads (Table 4-81).

Table 4-81. Miles of New Roads in the Project Area by Alternative

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Miles of new roads in the area	325	274	526	72	106	198

4.7.1.2 Alternative B: Reduced Development

Under Alternative B, potential destruction of fossils would occur on 5,213 acres (2.8%) and 472 acres (2.7%) of *Condition Class 1* and *3* areas, respectively. In *Condition Class 1* areas, this would be approximately 3 times more surface disturbance as compared to the No Action Alternative. In *Condition 3* areas, this would be approximately 1.5 times more disturbance than the No Action Alternative. In PFYC *Class 2* and *5* areas, 472 acres (2.7%) and 5,213 acres (2.8%) of surface disturbance, respectively, would occur, resulting in potential destruction of fossil material. This represents approximately 1.5 times more surface disturbance in *Class 2* areas over the No Action Alternative, and approximately 3 times more surface disturbance in *Class 5* areas over the No Action Alternative (see Table 4-80).

Potential beneficial impacts on paleontological resources of Alternative B would result from a total of 5,685 acres (2.8%) of surface disturbance, collectively, in *Condition Class 1* and *3* areas, and 5,685 acres (2.8%) of surface disturbance, collectively, in PFYC *Class 2* and *5* areas. Compared to the No Action Alternative, this is approximately 3 times more surface disturbance in *Condition Class 1* and *3* lands and PFYC *Class 2* and *5* lands (see Table 4-80).

Indirect adverse impacts related to an expanded road network (and therefore expanded access for illegal fossil collection) would be greater under Alternative B than under the No Action Alternative. Alternative B would result in 274 miles of new roads, approximately 4 times more than under the No Action Alternative (see Table 4-81).

4.7.1.3 Alternative C: Full Development

Under Alternative C, potential destruction of fossils would occur on 8,911 acres (4.7%) and 1,067 acres (6.1%) of *Condition Class 1* and *3* areas, respectively. In *Condition Class 1* areas, this would be approximately 5 times more surface disturbance as compared to the No Action Alternative. In *Condition 3* areas, this would be approximately 3.5 times more surface disturbance as compared to the No Action Alternative. In PFYC *Class 2* and *5* areas, 1,067 acres (6.1%) and 8,911 acres (4.7%) of surface disturbance, respectively, would occur, resulting in potential destruction of fossil material. This represents approximately 3.5 times more surface disturbance in *Class 2* areas over the No Action Alternative, and approximately 5 times more surface disturbance in *Class 5* areas than under the No Action Alternative (see Table 4-80).

Potential beneficial impacts on paleontological resources of Alternative C would result from a total of 9,978 acres (4.8%) of surface disturbance, collectively, in *Condition Class 1* and *3* areas, and 9,978 acres (4.8%) of surface disturbance, collectively, in PFYC *Class 2* and *5* areas. Compared to the No Action Alternative, this is approximately 5 times the surface disturbance in both *Condition Class 1* and 3 and PFYC *Class 2* and *5* lands (see Table 4-80).

Indirect adverse impacts related to an expanded road network (and therefore expanded access for illegal fossil collection) would be greater under Alternative C than under the No Action Alternative. Alternative C would result in 526 miles of new roads; approximately 7 times the amount under the No Action Alternative (see Table 4-81).

4.7.1.4 Alternative D: No Action

The No Action Alternative is the baseline to which the Proposed Action and action alternatives are compared. Under the No Action Alternative, adverse impacts to fossil resources would result from 1,748 acres (0.9%) and 308 acres (1.8%) of surface disturbance in *Condition Class 1* and *3* areas, respectively. Surface disturbance in PFYC *Class 2* and *5* areas would be 308 acres (1.8%) and 1,748 acres (0.9%), respectively (see Table 4-80).

Under the No Action Alternative, potential beneficial impacts associated with the unearthing of fossils would result from 2,056 acres (1.0%) of surface disturbance, collectively, in *Condition Class 1* and *3* areas, and 2,056 acres (1%) of surface disturbance, collectively, in PFYC *Class 2* and *5* areas (see Table 4-80).

Finally, indirect adverse impacts to paleontological resources associated with an expanded road network would result from 72 miles of new roads under the No Action Alternative (see Table 4-81).

4.7.1.5 Alternative E: Reduced Development with Directional Drilling

Under Alternative E, potential destruction of fossils would occur on 1,902 acres (1.0%) and 272 (1.6%) of *Condition Class 1* and *3* areas, respectively. In *Condition Class 1* areas, this would be a 154 acre increase in surface disturbance compared to the No Action Alternative. In *Condition 3* areas, this would be a 36 acre decrease in surface disturbance compared to the No Action Alternative. In PFYC *Class 2* and *5* areas, 272 acres (1.6%) and 1,902 acres (1.0%) of surface disturbance, respectively, would occur resulting in potential destruction of fossil material. This represents a 36 acre decrease in surface disturbance in *Class 2* areas over the No Action Alternative, and a 154 acre increase in surface disturbance in *Class 5* areas over the No Action Alternative (see Table 4-80).

Potential beneficial impacts to paleontological resources of Alternative E would result from a total of 2,174 acres (1.0%) of surface disturbance, collectively, in *Condition Class 1* and *3* areas, and 2,174 acres (1.0%) of surface disturbance, collectively, in PFYC *Class 2* and *5* areas. Compared to the No Action Alternative, this is a 118 acre increase in surface disturbance in *Condition Class 1* and *3* lands and PFYC *Class 2* and *5* lands (see Table 4-80). Indirect adverse impacts related to an expanded road network (and therefore expanded access for illegal fossil collection) would be greater under Alternative E than under the No Action Alternative. Alternative E would result in 106 miles of new roads, 34 more miles than under the No Action Alternative (see Table 4-81).

4.7.1.6 Alternative F: Agency Preferred Alternative

Under Alternative F, potential destruction of fossils would occur on 3,367 acres (1.8%) and 234 acres (1.3%) of *Condition Class 1* and *3* areas, respectively. In *Condition Class 1* areas, this would be a 1,619 acre increase in surface disturbance compared to the No Action Alternative. In *Condition 3* areas, this would be a 74 acre decrease in surface disturbance compared to the No Action Alternative. In PFYC *Class 2* and *5* areas, 234 acres (1.3%) and 3,367 acres (1.8%) of surface disturbance, respectively, would occur resulting in potential destruction of fossil material. This represents a 74 acre decrease in surface disturbance in *Class 2* areas over the No Action Alternative, and a 1,619 acre increase in surface disturbance in *Class 5* areas over the No Action Alternative (see Table 4-80).

Potential beneficial impacts to paleontological resources of Alternative F would result from a total of 3,601 acres (1.7%) of surface disturbance, collectively, in *Condition Class 1* and *3* areas, and 3,601 acres (1.7%) of surface disturbance, collectively, in PFYC *Class 2* and *5* areas. Compared to the No Action Alternative, this is approximately 1.8 times the surface disturbance in both *Condition Class 1* and 3 and PFYC *Class 2* and *5* lands (see Table 4-80).

Indirect adverse impacts related to an expanded road network (and therefore expanded access for illegal fossil collection) would be greater under Alternative F than under the No Action Alternative. Alternative F would result in 198 miles of new roads, 126 more miles than under the No Action Alternative (see Table 4-81).

4.7.2 Mitigation

No additional mitigation measures are proposed.

4.7.3 Unavoidable Adverse Impacts

Subsurface disturbance, potential destruction of paleontological resources, and increased access to paleontological resources through an expanded road network are unavoidable adverse impacts. These would occur to some extent regardless of mitigation, as described above.

Paleontological mitigation seeks to salvage as many significant fossils as possible prior to their destruction during human-induced ground disturbance. Measurable performance standards in paleontology apply to monitoring and mitigation procedures, which ensure that fossil sites are documented thoroughly and accurately, and that fossils are collected according to professional paleontological standards.

As a nonrenewable resource, paleontological resources are unique. At the time fossils are discovered, they have already been subjected to a variety of destructive processes. These may include a combination of predation, scavenging, disarticulation, transport, primary weathering, erosion, secondary weathering, and damage through ground disturbance. It is difficult to develop measurable performance standards for paleontological mitigation because

- fossils have been damaged by natural processes prior to their discovery;
- fossils are typically further damaged by construction activities that reveal their presence to paleontological monitors; and
- fossil numbers are impossible to quantify, as there is no way to know how many fossils existed at the project site but were not exposed during construction.

Therefore, the absence of fossils would not indicate failure of the mitigation measures.

4.7.4 Irretrievable and Irreversible Commitments of Resources

All adverse impacts (direct and indirect) would be considered long-term; once fossils are destroyed, they can never be regenerated or replaced. All commitments of resources, therefore, would be irreversible.

4.7.5 Relationship of Short-term Uses to Long-term Productivity

Proper mitigation would reduce but not eliminate impacts to long-term paleontological resources due to short-term oil and gas development. Short-term oil and gas development, therefore, would impact long-term paleontological resources via the destruction of these resources during ground-disturbing activities.

4.8 Recreation

The potential effects of the construction and operation of the proposed natural gas recovery facilities on recreational resources are calculated based on an analysis of how many recreational opportunities would be lost versus how many would be created. Direct impacts to recreation would occur if acreage that is currently available for recreation were used for natural gas exploration and development, or if additional recreational opportunities are created by an expanded road network and project-related surface disturbances. The facilities and structures proposed under Alternative A (Proposed Action) and the other alternatives would likely impact recreational opportunities by restricting or changing access to sites, or by directly disrupting current activities such as use of the Nine Mile Canyon Special Recreation Management Area (SRMA), for hunting, off-highway vehicle (OHV) use where allowed, wetlands recreation, and hiking. Additionally, impacts to river recreationists would include visual and noise impacts associated with wells along the Green River floodplain. Specific impacts are discussed below in the analysis of river recreation. Construction and operation of proposed facilities could also create a visual intrusion on the recreational experience (e.g., feelings of satisfaction) sought by recreationists who value unobstructed viewsheds and relatively natural settings for their activities (BLM 2005a, BLM 2006b). In addition to obstructed viewsheds, the potential impacts to recreationists' satisfaction would include odors from evaporative facilities and noise from generators. These impacts are only anticipated within approximately 0.5 mile of the proposed evaporative facility under all alternatives, and are therefore not discussed further below.

The noise of construction and operation of producing wells, including the presence of work crews, vehicles, and equipment, would reduce primitive recreational opportunities in proximity to development. As shown in Table 3-17, noise levels from common construction equipment average 88 dBA at 50 feet (EPA 1971; Barnes et al. 1976) from the site. Construction noise levels would be short-term (30 to 40 days) and spatially limited and would be most noticeable during the development phase when construction, drilling, and completion activities would occur. Elevated noise levels would also occur along access roads as vehicles and heavy equipment traveled to each site. During the production phase, noise and human activity would generally be limited to 1 or 2 vehicles per day (e.g., pumper and water/condensate trucks), but may also include increases in recreation and/or administrative traffic associated with the construction of new or improved access roads.

As recreational visitors move away from the sources of development and incompatible land uses, the sights and sounds of these intrusions would diminish. Direct impacts on opportunities for primitive recreation result from changes in the recreation setting caused by direct surface disturbances (measured in acres). It is conservatively assumed for the purposes of analysis that sights and sounds from development and incompatible land uses would cause interference and reduce opportunities for primitive recreation up to 0.5 mile beyond areas directly impacted (Table 4-82.). The 0.5-mile threshold is based on the approximate distance estimated to reduce or attenuate peak well-pad development noise (approximately 88 dB) to to 55 dBA and below (levels that would not cause interference with recreational activities). A recreationist would have to travel up to 2.2 miles away from the source to reach a point where noise levels would be 40 dBA or less, and up to 9.1 miles to reduce noise levels to 25 dBA or potential nighttime ambient conditions in remote parts of the project area (see Table 4-82.). However, as noted in Chapter 3, 40 dBA gives the subjective impression of quiet so it would not be necessary to travel this far to reach quiet conditions. It should be noted that this GIS-based analysis does not take into consideration variables such as existing road conditions and/or use, visual and topographical screening, or noise propagation in mountainous/canyon terrain. Therefore, opportunities for primitive recreation would likely exist in isolated areas within the 0.5-mile buffer. Normally, an undeveloped area of large size is needed to provide a setting that supports opportunities for primitive recreation. Additional effects on areas offering opportunities for primitive recreation were measured by actions that would segregate undeveloped areas with these characteristics into parcels smaller than 5,000 acres, as such reductions would affect these opportunities.

Table 4-82. Noise Levels from Common Construction Equipment and Attenuation Distances[1]

Construction Equipment	Typical Sound Pressure Level, dBA									
	50 feet	100 feet	500 feet	1,500 feet[2]	2,500 feet (.47miles)	3,000 feet (.57 miles)	6,000 feet (1.1 miles)	12,000 feet (2.2 miles)	24,000 feet (4.5 miles)	48,000 feet (9.1 miles)
Dozer (250–700 hp) Front End Loader (6–15 cu. yards)	88	82	68	58	54	52	46	40	34	28
Trucks (200–400 hp)	86	80	66	56	52	50	44	38	32	26
Grader (13–16 foot blade)	85	79	65	55	51	49	43	35	29	25
Shovels (2–5 cu. yards) Portable Generators (50–200 kilowatts [kW])	84	78	64	54	50	48	42	36	30	24
Derrick or Mobile Crane (11–20 tons)	83	77	63	53	49	47	41	35	29	23
Concrete Pumps (30–150 cu. yards)	81	75	61	51	47	45	38	32	26	20

Source: U.S. EPA (1971); Barnes et al. (1976).

[1] When one doubles the distance from a noise source the recorded noise level is reduced by 6 dB. This is also called the Rule of 6. This is based on the fact that the equation to calculate noise attenuation at a distance D2, knowing the SPL at distance D1 is given by $10log_{10}\left[\left(\frac{D_2}{D_1}\right)^2\right] = 20log_{10}\left[\frac{D_2}{D_1}\right]$, where D is the distance. If the distance is doubled, the equation simplifies to 20 * $log_{10}(2)$ which equals 6.02 (or approx. 6)

[2] At this distance and greater, ground attenuation would be substantial. Nonetheless it was excluded for conservatism.

Short-term impacts would occur during the construction phase of the project. These impacts would take place at focused sites within the project area over a period of approximately 15 years, until all wells and their associated roads and pipelines were constructed. Short-term impacts related to construction are likely only to affect relatively small percentages of the project area during a given year. Long-term impacts would occur throughout the estimated 45-year life of the project.

Though the roads leading to the Sand Wash put-in would provide views of dozens of gas wells, it is unlikely that any gas-well activity (construction or operation) would be seen or heard from the river. Once people set off in their boats down the river, it would take only a couple of miles for them to have have moved off the project site and between the steep canyon walls of Desolation Canyon.

Closely related to recreation, impacts to visual resources (Section 4.14), and land use and transportation (Section 4.5) are addressed in separate sections.

Where possible, the potential impacts of project activities to recreation resources are presented quantitatively. Potential impacts to recreational resources would include

- acres of land converted from their current condition to natural gas production;
- miles of new roads (providing access to additional recreation opportunities or disturbing areas previously used by non-motorized or non-mechanized recreationists);
- number of wells, acres of disturbance, and miles of new roads in the Nine Mile Canyon SRMA;
- acres of disturbance in designated OHV Limited areas;
- miles of new roads in designated OHV Limited areas;
- number of wells and acres of disturbance within the Pariette Wetlands Area of critical environmental concern (ACEC);
- wells sited and total acres of disturbance within 3 miles (east and west) of Wells Draw (on the bench above Nine Mile Canyon), which would potentially impact the wilderness therapy group Second Nature use of this area; and
- number of wells visible from the Green River.

4.8.1 Direct and Indirect Effects

The types of direct and indirect effects on recreation resources would be the same under all alternatives because they would use the same well drilling and gas production methods, with the same surface disturbances, pipeline and infrastructure construction, and night lighting. However, project-related impacts would vary in degree, based on the number of wells and associated roads, pipelines, and other facilities proposed. Potential impacts are described in greater detail under Alternative A (Proposed Action) than under Alternative B, Alternative C, the No Action Alternative (Alternative D), Alternative E, and Alternative F because the initial description of impacts discussed under Alternative A can be applied to the other alternatives. Impacts associated with the Proposed Action and Alternatives B, C, E, and F are compared to the No Action Alternative.

4.8.1.1 Alternative A: Proposed Action

Under the Proposed Action, the potential long-term adverse effects on recreation would include a decrease in recreational opportunities due to the direct conversion of 5,880 acres of land to well-drilling facilities (well pads and evaporation facilities; see Table 4-83). The potential long-term beneficial effects on recreation under the Proposed Action would include increased recreational opportunities through access to previously inaccessible areas due to the expanded road network (325 miles of new roads; see Table 4-83). New access would provide benefits to some types of recreationists, motorized and mechanized users in particular would receive the greatest benefits (OHV users would benefit most from an expanded road network because roads, in large part, provide not only access, but are a resource for this form of recreation).

The short-term adverse effects on recreation would include increased noise levels of up to 88 dBA at 50 feet during the construction period, which would reduce opportunities for solitude and primitive recreation. Recreationists would have to move up to 0.5 mile to reach a point where attenuation would reduce noise levels to 55 dBA or below, and up to 2.3 miles to reduce noise levels back to 40 dBA (or "quiet"), and up to 9.1 miles to reduce noise levels back to potential nighttime ambient conditions of approximately 25 dBA (Table 4-82.). The actual noise levels experienced by a receptor, however, would depend on the distance between the receptor and the equipment, the topography, vegetation, and meteorological conditions (e.g., wind speed and direction, temperature, humidity). Ground attenuation would likely reduce the abovementioned estimations for any distances over 1,500 feet from the noise receptor. As stated in Chapter 3, 55 dBA and below are identified as levels that would not cause interference in outdoor activities and 40 dBA gives the subjective impression of "quiet."

Temporary and intermittent noise impacts from increased vehicle use in the area during construction would also reduce opportunities for solitude and primitive recreation. During the production phase, noise and human activity would generally be limited to 1 or 2 vehicles per day (e.g., pumper and water/condensate trucks), and increases in recreation and/or administrative traffic associated with the construction of new or improved access roads.

Compared to the No Action Alternative, this alternative would have more potentially adverse impacts on recreational opportunities because 1,123 more wells would be developed and 4,425 more acres would be impacted by well pad and evaporation faciltities construction. This would distract from the recreational experience to a greater degree than would the No Action Alternative because the development of more wells would create additional noise and the development period would be of a longer duration. However, this alternative would potentially create more opportunities for OHV recreation by 253 more miles of project-related access roads.

Table 4-83. Acres of Disturbance from Well Pads and Evaporation Facilities and Miles of New Roads by Alternative

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alterative F (Agency Preferred)
Acres of disturbance from well pads and evaporation facilities	5,880	4,390	7,442	1,455	1,527	2,501
Miles of new roads	325	274	526	72	106	198

4.8.1.1.1 Nine Mile Canyon SRMA

The Nine Mile Canyon SRMA is a popular destination for scenic drivers, OHV users, tourists, and to a limited extent, mountain bikers and hikers. Under the Proposed Action, 146 wells would be built within the boundaries of the existing SRMA. A total of 792 acres of surface disturbance from well pads, roads, and pipelines would occur within the SRMA (Table 4-84). This would reduce the suitability of 1.8% of the designated 44,168 acres of the SRMA for recreational use from project-related disturbances (see Table 4-84). A conversion of land from recreation to gas development would constitute a long-term adverse impact to recreation in the Nine Mile Canyon SRMA because this land would be altered, with reduced recreational opportunities, until successful reclamation was completed.

Table 4-84. Well Sites, Miles of New Roads, and Estimated Surface Disturbance (acres and percentage of total SRMA) in the Nine Mile Canyon SRMA by Alternative

Nine Mile Canyon SRMA	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Wells (number)	146	43	182	17	14	134
New roads (miles)	46	32	79	5	7	31
Nine Mile Canyon SRMA surface disturbance from roads, pipelines, and well pads (acres)	792	283	1,114	104	107	491
Percentage of SRMA Affected (based on designation of 44,168 acres within SRMA)	1.8%	0.6%	2.5%	0.2%	0.2%	1.1%

It is likely that gas wells on BLM-managed land would be visible to visitors from roads and two-tracks within the Nine Mile Canyon SRMA. However, applicant-committed BMPs for the site-specific use, where appropriate, of buried pipelines and centralized water and condensate tank facilities would reduce the visual impacts of pipelines and tanks. Additionally, increased traffic may impact visitors along Nine Mile Canyon Road, Sand Wash Road, and other roads used to access the canyon. Impacts to particular transportation routes are discussed in Section 4.5 (Land Use and Transportation). It is not possible to quantify the impact on visitor numbers or patterns of recreation in the area from visible gas wells, but it is likely to change the land's natural character as perceived by recreationists (see Section 4.14, Visual Resources).

Within the SRMA, 19,658 acres were inventoried to provide opportunities for primitive recreation (hiking, horseback riding, climbing, river floating, fishing, viewing/studying cultural and historic sites, viewing wildlife, and viewing scenic landscapes) in an undeveloped landscape setting (BLM 2007h). Under the Proposed Action, 86 natural gas wells would be drilled in this less developed portion of the SRMA, resulting in direct surface disturbance of 454 acres from construction of roads, well pads, and related infrastructure. The presence and noise of people, vehicles, and equipment needed for construction and operation of the wells would reduce the opportunities for non-motorized and primitive forms of recreation currently available in this portion of the SRMA. Further, the noise and presence of people and machinery would intermittently and temporarily diminish opportunities for visitors to feel alone in an undeveloped setting on 9,300 acres, or 47%, of this less developed portion of the SRMA that would fall within 0.5 mile of areas that are directly disturbed. Assuming that 5,000 acres is the minimum size necessary to provide an adequate setting for primitive recreation and experiences, natural gas development under the Proposed Action would reduce opportunities for primitive recreation on 663 acres of the SRMA that would be segregated into parcels smaller than that size. These areas would be transformed from less developed landscapes offering primitive recreational opportunities and experiences to a more roaded, developed, and industrial landscapes providing opportunities for more motorized forms of recreation.

The development of additional roads within the SRMA would likely constitute a beneficial, long-term impact to many recreationists, because the roads would allow greater access. There are currently 56 miles of roads in the Nine Mile Canyon SRMA. Approximately 46 miles of new roads would be constructed under the Proposed Action (see Table 4-84), almost doubling the total miles of roads in the SRMA. Compared to the No Action Alternative, this alternative would adversely impact 1.6% more of the SRMA through surface disturbances and infrastructure construction. The Proposed Action would construct 41 more miles of new roads, with potentially beneficial impacts from increased access to the SRMA.

4.8.1.1.2 Vernal Extensive Recreation Management Area (ERMA)

Areas not managed as SRMAs are managed as part of the Extensive Recreation Management Area (ERMA) for dispersed recreation uses that require little facility development. Within the project area, 174,018 acres are managed as part of the ERMA. Much of the ERMA is a roaded and developed landscape. As described above, construction of access roads, well pads, and related natural gas production infrastructure would increase opportunities for motorized forms of recreation like backcountry driving and sightseeing and vehicle-supported activities like camping, fishing, picnicking, and wildlife viewing. However, the production of natural gas would further change the setting to a more developed landscape in which these activities would take place.

A 20,396 acre portion of the ERMA, east and west of the Little Desert Road, was found to provide opportunities for primitive recreation in an undeveloped landscape setting during BLM's most recent wilderness characteristics inventory (BLM 2007h). Under the Proposed Action, 136 natural gas wells would be drilled in this portion of the ERMA, resulting in direct surface disturbance of 729 acres. The presence and noise of people, vehicles, and equipment needed for construction and operation of the wells would reduce the opportunities for non-motorized and primitive forms of recreation currently available in this portion of the ERMA. Further, the noise and presence of people and machinery would intermittently and temporarily diminish opportunities for visitors to feel alone in an undeveloped setting on 15,173 acres, or 74%, of this less developed portion of the ERMA that would fall within 0.5 mile of areas that are directly disturbed. Development under the Proposed Action would reduce opportunities for primitive recreation on 5,742 acres of the ERMA that would be segregated into parcels smaller than 5,000 acres.

4.8.1.1.3 River Recreation

Impacts to river recreationists would include visual and noise impacts associated with wells within sight of Nine Mile Creek and the Green River and additional large truck traffic on the Wrinkle and Sand Wash Roads. No wells or miles of road would be visible within the viewshed of Nine Mile Creek (Table 4-85). Within the Green River's viewshed, 11 wells and 1 mile of road would be visible (and possibly audible during drilling; see Table 4-85). Although all well development would be upriver (or north) of the Sand Wash put-in, recreationists accessing downstream areas through the project area would be affected by increased noise levels and visual impacts. However, there are no wells proposed within 1 mile of the Sand Wash put-in and only three within 2 miles (all on state lands) so impacts are expected to be minor because of the distance. It would be unlikely that the recreational experience at the Sand Wash Campground would be affected by the increase in noise levels from well development because the ambient noise levels are higher there than in the river corridor. Visual and noise impacts experienced on the stretch of the Green River to north of the Sand Wash put-in would not affect as many visitors as recreational use is lower; however, because of the increased number of wells that would be developed, impacts to the recreational experience would be greater and of a longer duration.

There would be no direct impacts to the area considered under the Green River Management Plan. However, the potential indirect effects from noise and visual intrusions near the Sand Wash put-in may require additional mitigation at the site-specific permitting stage to comply with management objectives stated in the 1979 plan. Under the implementation section of *Management Action #5 Suspend Oil and Gas Exploration* of the plan it states the following: "Do not authorize requests for drilling within the previously mentioned river corridor (within sight or sound of the river)."

Applicant-committed BMPs for the site-specific use of buried pipelines where appropriate and centralized water and condensate tank facilities would reduce the visual impacts of pipelines and tanks. In addition, river recreationists launching from the Sand Wash put-in would quickly move away from any sights and sounds of development.

Compared to the No Action Alternative, this alternative would have the same number of visible wells within the Green River viewshed and one less mile of visible road. The impacts to the Nine Mile Creek viewshed would be the same (no wells or roads visible).

Table 4-85. Wells and Miles of New Roads Visible from Nine Mile Creek and the Green River by Alternative

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Nine Mile Creek Viewshed						
Wells (number)	0	0	12	0	0	0
New roads (miles)	0	0	3	0	0	0
Green River Viewshed						
Wells (number)	11	15	26	11	4	0
New roads (miles)	1	3	5	2	1	1

4.8.1.1.4 HUNTING

Big-game hunters would receive long-term direct benefits from natural gas development in the area due to the expanded road network that would be created. However, this direct benefit may only be experienced by a small percentage of hunters and could be outweighed by the long-term direct and indirect adverse effects of habitat reduction, lower forage productivity, noise, and persistent human presence. The expanded road network (325 miles of new roads under the Proposed Action; see Table 4-83) would increase access to hunting grounds within the project area.

Long-term indirect adverse effects to big-game hunters, related to elk and deer populations and behavior, would also result from natural gas development in the project area. Roads have been shown to reduce habitat value for elk and deer, decreasing the likelihood of hunters finding elk and deer in areas with new roads. Habitat conversion and fragmentation due to the construction of wells would also indirectly impact big-game hunting, as the elk and deer would have fewer resources for cover, forage, and breeding grounds. (For a full discussion of the impacts of natural gas development on elk, deer, and other wildlife species, see Section 4.16, Wildlife.)

Constructing a network of new roads would result in loss of wildlife habitat, loss of forage (food) for wildlife consumption, noise, and persistent human presence which would negatively affect wildlife populations and use of the area. Increased road mileage would detract from the experience of hunters who value the experience of hunting in a natural setting removed from motorized sights and sounds.

Small-game hunting occurs diffusely across the project area. Small-game hunters would sustain similar impacts from gas development as discussed for big-game hunters. Adverse impacts would include loss of cover and breeding areas for game species (and associated loss of hunting grounds) due to the direct conversion of vegetated land to gas wells and roads. Though some small game species (e.g., sage-grouse) are likely to avoid developed areas, others, such as cottontail, are frequently found around gas-well facilities (BLM 2006e). Consequently, the impacts of project construction to small-game hunters are likely to depend on which species is being hunted. The construction of additional roads throughout small-game hunting habitats would increase access for hunters in vehicles, potentially increasing their success rates depending on the species hunted. Compared to the No Action Alternative, the Proposed Action would have more long-term, beneficial impacts from increased access to hunting areas from road construction from an additional 253 miles of roads. There would be more adverse, long-term impacts from the Proposed Action from increased habitat fragmentation and habitat conversion because 4,425 more acres would be impacted by well pad and evaporation facility construction.

4.8.1.1.5 OHV RECREATION

Natural gas development in the project area would result in direct long-term adverse impacts to OHV users through the alteration of lands for purposes of well drilling, completion, and production activities. Areas that are currently designated as Limited Use would be altered by the construction of well pads and pipelines in the project area (Table 4-86). However, applicant-committed BMPs for the site-specific use of buried pipelines where appropriate would reduce the impacts of pipelines on OHV travel. Any new natural gas activity in areas currently designated as closed to OHV use would not impact OHV users because these areas would remain closed. Approximately 6,281 acres (3.5%) of land designated as Limited Use, would be converted to well pads and altered for OHV use.

Table 4-86. Acres of Disturbance by OHV Status and Alternative

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Acres of disturbance in land designated as closed to OHV use (and % of total acres closed)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Total area of land in project area designated as closed to OHV use (acres)	**4**					
Acres of disturbance in land designated as OHV limited* (and % of total)	6,281 (3.5%)	4,475 (2.5%)	8,442 (4.8%)	1,534 (0.9%)	1,737 (1.0%)	2,978 (1.7%)
Total area of land in project area designated as limited (acres)	**177,552**					
Total area of land in project area designated as open to overland OHV use (acres)	**0**					

*This includes year-long and seasonal-use areas.

OHV users would gain direct, long-term beneficial recreational opportunities with the addition of 269 miles of OHV access roads within areas where OHV use is Limited (Table 4-87). Compared to the No Action Alternative, this alternative would more long-term beneficial impacts on OHV recreational opportunities because more miles of access roads would be available for OHV travel.

Table 4-87. Miles of New Access Roads in Closed and Limited OHV Use Areas

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Miles of new access roads in areas closed to OHV use	0	0	0	0	0	0
Miles of new access roads in areas with limited OHV use*	269	188	371	52	83	162
Total new access roads in designated OHV use areas	269	188	371	52	83	162

*This includes year-long and seasonal use areas.

4.8.1.1.6 WETLANDS RECREATION

For the purposes of this analysis, it is assumed that the border of the Pariette Wetlands ACEC is the effective border of the Pariette Wetlands. Under the Proposed Action, 11 acres of disturbance to riparian areas within the borders of the ACEC would be altered for recreation due to natural gas development (Table 4-88) (mitigation measures for impacts to riparian areas are outlined in Section 4.15.2, Mitigation). In addition to surface disturbance, wells in this area could adversely and indirectly impact visitor recreational satisfaction by disturbing waterfowl (see Section 4.14, Visual Resources). Compared to the No Action Alternative, this alternative would have more long-term, adverse impacts to wetlands recreation because more riparian area would be affected by project-related disturbances.

Table 4-88. Acres of Disturbance within the Border of Pariette Wetlands ACEC by Alternative

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred))
Acres of disturbance within the border of the Pariette wetlands ACEC	11	0	4	0	0	0

4.8.1.1.7 HIKING

Few recreationists use the project area for hiking because there are limited opportunities for satisfactory experiences (see Section 3.8, Recreation); as such, there would be relatively minor adverse impacts to this recreation user group from the development of natural gas resources. The only consistent use of the land within the project area by people on foot is by the wilderness therapy group Second Nature. The group runs camps on the bench above Nine Mile Canyon, and staff and students walk the land in the area approximately 3 miles east and west of Wells Draw. Most of the hiking is overland and does not depend on trails or roads; group members spend a majority of their time in roadless areas. Construction and operation of gas wells in this area would have the potential to adversely impact the recreational experience through visual intrusion of constructed roads and wells, and the direct reduction of undisturbed land available for hiking. However, applicant-committed BMPs for the site-specific use where appropriate of buried pipelines and centralized water and condensate tank facilities would reduce the visual impacts and the potential impacts to the recreational experience of project pipelines and tanks. Additionally, the potential also exists for an increase in escapees from the program through hitchhiking. Under the Proposed Action, 231 wells and 58 miles of new roads would be sited within 3 miles (east and west) of Wells Draw. Total acres of disturbance in the area (from wells, pipelines, and roads) would be approximately 1,192 acres (Table 4-89). Current disturbance within 3 miles, east and west, of Wells Draw is approximately 284 acres, 238 acres from roads and 46 acres from well pads. Compared to the No Action Alternative, this alternative would have more adverse, long-term impacts to the Wells Draw area recreational experience because a larger area would be disturbed and more roads would be created.

Table 4-89. Well Sites, Miles of New Roads, and Acres of Disturbance within a 3-mile Radius of Wells Draw

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Well sites	231	226	419	76	69	129
Miles of new access roads	58	57.7	100	15.9	29	50
Total acres of disturbance	1,192	1,175	2,184	450	460	819

4.8.1.2 Alternative B: Reduced Development

Under Alternative B, the number of wells developed would be 1,114, and well-pad locations would be precluded from some sensitive areas. Long-term adverse effects on recreation from the direct alteration of land for recreational use due to well-drilling facilities (well pads and evaporation facilities) would be increased under Alternative B, because 4,390 acres of disturbance for well pads and evaporative facilities would occur, which is 2,935 more acres and 746 more wells than under the No Action Alternative (see Table 4-83 and Table 2-7). However, applicant-committed BMPs for the site-specific use of buried pipelines and centralized water and condensate tank facilities would reduce the visual impacts of pipelines and tanks where appropriate.

Noise impacts from each well constructed under Alternative B would be the same as described under the Proposed Action (see Section 4.8.1.1). However, 377 fewer wells would be developed, so fewer potential recreation areas would be affected and the duration of the temporary noise impacts would be less. Compared to the No Action Alternative, this alternative would have more potentially adverse impacts on recreational opportunities because 746 more wells would be developed creating additional noise and a development period of longer duration.

Long-term beneficial effects on OHV recreation would increase under Alternative B compared to the No Action Alternative, because the proposed expanded road network would be 274 miles, 202 more miles than No Action (see Table 4-83). In an overall comparison to the No Action Alternative, Alternative B would have more adverse impacts to recreation from land alteration, visual impacts and noise, which would affect recreational opportunities. There would be more beneficial effects to OHV recreation than under Alternative B from an expanded road network.

4.8.1.2.1 Nine Mile Canyon SRMA

Under Alternative B, 283 acres of surface disturbances (with disturbances similar to those described under the Proposed Action) would occur within the Nine Mile Canyon SRMA, compared to 104 acres of surface disturbance under the No Action Alternative. The percentage of the existing Nine Mile Canyon SRMA that would be disturbed and have an impact on recreational opportunities within the SRMA would be 0.6% under Alternative B, compared with 0.2% under the No Action Alternative (see Table 4-84).

Under Alternative B, no wells would be drilled in the undeveloped portion of the SRMA that currently provides opportunities for primitive recreation. There would be, however, 18 acres of surface disturbance related to the construction of infrastructure (i.e., roads and pipelines) associated with wells outside the undeveloped portion of the SRMA. Although natural gas development would physically disturb very little of the less developed portion of the SRMA, the noise and presence of people and machinery would intermittently and temporarily diminish opportunities for visitors to feel alone in an undeveloped setting within 0.5 mile of areas that are directly disturbed. This indirect disturbance would occur on 5,687 acres, or 29% of the less developed portion of the SRMA. Natural gas development under Alternative B would reduce opportunities for primitive recreation on 20 acres of the SRMA that would be segregated into parcels smaller than 5,000 acres.

Approximately 32 miles of new roads (27 more miles than under the No Action Alternative) would be available to recreationists under Alternative B. This represents an increased long-term benefit to recreationists under Alternative B compared to the No Action Alternative because of the increased access opportunities (see Table 4-84). Under Alternative B, the total length of roads in the Nine Mile Canyon SRMA would increase from 56 to 88 miles.

4.8.1.2.2 Vernal Extensive Recreation Management Area

Under Alternative B, no natural gas wells would be drilled in the portion of the ERMA that runs east and west of the Little Desert Road. This portion currently provides opportunities for primitive recreation. However, roads and pipelines would result in direct surface disturbance of 6 acres. The presence and noise of people, vehicles, and equipment needed for construction and operation of the wells would reduce the opportunities for non-motorized and primitive forms of recreation that currently available in this portion of the ERMA. Further, the noise and presence of people and machinery would intermittently and temporarily diminish opportunities for visitors to feel alone in an undeveloped setting on 7,008 acres, or 34% of this less developed portion of the ERMA—which would fall within 0.5 mile of areas that are directly disturbed. Development under Alternative B would reduce opportunities for primitive recreation on 8 acres of the ERMA that would be segregated into parcels smaller than 5,000 acres.

4.8.1.2.3 River Recreation

Under Alternative B, there would be no visual and noise impacts to river recreationists along Nine Mile Creek because no wells or new roads would be visible from the creek. Within the Green River's viewshed, 15 wells and 3 miles of roads would be visible (and possibly audible during drilling), which is four more wells and 1 more mile of road than would be visible under the No Action Alternative (see Table 4-85). Impacts would be of the same nature as those described under Alternative A except that they would be of a greater degree due to the greater number of wells and miles of road within the Green River's viewshed.

However, applicant-committed BMPs for the site-specific use where appropriate of buried pipelines and centralized water and condensate tank facilities would reduce the visual impacts of pipelines and tanks.

4.8.1.2.4 HUNTING

Big-game hunters would receive more long-term direct benefits from natural gas development in the project area under Alternative B than under the No Action Alternative because there would be 274 miles of new roads, which is 202 more miles than under the No Action Alternative (see Table 4-83).

Alternative B would also result in more long-term indirect adverse impacts to big-game hunters with regard to elk and deer populations and behavior (see Section 4.16, Wildlife), with similar impacts to those discussed under the Proposed Action; 4,390 acres of disturbance would occur from well pads and evaporation facilities, which is 2,935 more acres of disturbance than under the No Action Alternative (see Table 4-83).

Constructing a network of new roads would result in loss of wildlife habitat, loss of forage (food) for wildlife, noise, and persistent human presence which would negatively affect wildlife populations and use of the area. Increased road mileage would detract from the experience of hunters who value the experience of hunting in a natural setting removed from motorized sights and sounds.

4.8.1.2.5 OHV RECREATION

Under Alternative B, OHV users would incur more direct, long-term, adverse impacts (as discussed under the Proposed Action) than under the No Action Alternative because more wells would be drilled, and therefore more areas designated for limited OHV use would be altered by well pads and other project-related disturbance. Under Alternative B, where OHV use is limited, there would be 4,475 acres of potential disturbance, 2,941 more acres of disturbance than the No Action Alternative. Under Alternative B, approximately 2.5% (in OHV limited areas) of land would be altered from OHV use, compared to 0.9% under the No Action Alternative (see Table 4-86). However, applicant-committed BMPs for the site-specific use where appropriate of buried pipelines and would reduce the impact of pipelines on OHV access.

OHV users would also gain more benefits under Alternative B than under the No Action Alternative, because 188 miles of new roads (136 more miles than under the No Action Alternative) in areas where OHV use is limited would be constructed under Alternative B (see Table 4-87).

4.8.1.2.6 WETLANDS RECREATION

Under Alternative B, no acres of disturbance would occur within the border of the Pariette Wetlands ACEC. This alternative, therefore, would have no adverse impacts to wetlands recreationists (see Table 4-88). The impacts would be the same as under the No Action Alternative.

4.8.1.2.7 HIKING

Impacts to members of the wilderness therapy group Second Nature would be increased under Alternative B compared to the No Action Alternative. There would be 226 wells sited, 57.7 miles of new roads, and 1,175 acres of disturbance within a 3-mile radius of Wells Draw under Alternative B. This is 150 more wells, 41.8 more miles of new roads, and 725 more acres of surface disturbance within a 3-mile radius of Wells Draw (see Table 4-89) than under the No Action Alternative.

4.8.1.3 ALTERNATIVE C: FULL DEVELOPMENT

Under Alternative C, the number of wells developed would be 1,887. Long-term, adverse effects on recreation (similar to those discussed under the Proposed Action) from the direct alteration of land for recreational use due to well-drilling facilities (well pads and evaporation facilities would be increased under Alternative C compared to the No Action Alternative because there would be 1,519 more wells developed and the potential for 5,987 additional acres of disturbance from construction of well pads and evaporative facilities (see Table 4-83 and 2-7). This level of disturbance would be 80% greater than that which would occur under the No Action Alternative. However, applicant-committed BMPs for the site-specific use where appropriate of buried pipelines and centralized water and condensate tank facilities would reduce the visual impacts of pipelines and tanks.

Noise impacts from each well constructed under Alternative C would be the same as described under the Proposed Action (see Section 4.8.1.1). However, 396 more wells would be developed than under the Proposed Action so more recreation areas would potentially be affected and the duration of the temporary noise impacts would be longer.

Compared to the No Action Alternative, this alternative would have more potentially adverse impacts on recreational opportunities because 1,519 more wells would be developed and 7,442 more acres would be impacted by well pad and infrastructure construction. This would distract from the recreational experience to a greater degree than under the No Action Alternative and more than any other alternative because the development of more wells would create additional noise and would be of a longer duration.

Long-term beneficial effects on recreation access would increase under Alternative C compared to the No Action Alternative, because the potentially expanded road network would be 526 miles, 454 miles (86%) more than the No Action Alternative (see Table 4-83).

4.8.1.3.1 NINE MILE CANYON SRMA

Under Alternative C, 1,114 acres of surface disturbance would occur from roads, pipelines, and well pads. This is 1,010 more acres than under the No Action Alternative. The percentage of the existing Nine Mile Canyon SRMA that would be disturbed for recreation would be 2.5% under Alternative C, compared with 0.2% under the No Action Alternative (see Table 4-84).

Under Alternative C, 116 wells would be drilled in the less developed portion of the SRMA that currently provides opportunities for primitive recreation. There would be 715 acres of surface disturbance within the less developed portion of the SRMA related to construction of wells and other infrastructure. In addition, the noise and presence of people and machinery would intermittently and temporarily diminish opportunities for visitors to feel alone in an undeveloped setting on 19,538 acres, or 99% of this less developed portion of the SRMA—which would fall within 0.5 mile of areas that are directly disturbed. Natural gas development under Alternative C would reduce opportunities for primitive recreation on 5,071 acres of the SRMA that would be segregated into parcels smaller than 5,000 acres.

Approximately 74 more miles of new roads (79 miles of new roads total under Alternative C) would be available to recreationists under Alternative C than under the No Action Alternative. This represents an increased benefit to recreationists between Alternatives C and the No Action Alternative (see Table 4-84). Under Alternative C, the total length of roads in the Nine Mile Canyon SRMA would increase from 56 to 135 miles.

4.8.1.3.2 Vernal Extensive Recreation Management Area

The effects natural gas development have on the recreation activities, settings, and experiences of the undeveloped portion of the ERMA would be the same as described for Alternative A, but would affect different areas and acreages of the ERMA. Under Alternative C, 98 natural gas wells would be drilled in the portion of the ERMA that occurs east and west of the Little Desert Road and that currently provides opportunities for primitive recreation. This would result in direct surface disturbance of 533 acres. The presence and noise of people, vehicles, and equipment needed for construction and operation of the wells would reduce the opportunities for non-motorized and primitive forms of recreation currently available in this portion of the ERMA. Further, the noise and presence of people and machinery would intermittently and temporarily diminish opportunities for visitors to feel alone in an undeveloped setting on 17,905 acres, or 88% of this less developed portion of the ERMA—which would fall within 0.5 mile of areas that are directly disturbed. Development under Alternative C would reduce opportunities for primitive recreation on 8,894 acres of the ERMA that would be segregated into parcels smaller than 5,000 acres.

4.8.1.3.3 River Recreation

Under Alternative C, impacts to river recreationists include visual and noise impacts associated with wells along Nine Mile Creek and the Green River and additional large truck traffic on the Wrinkle and Sand Wash Roads. From Nine Mile Creek, 12 wells and 3 miles of roads would be visible (and possibly audible) to river recreationists, which is 12 wells and 3 miles more than under the No Action Alternative (see Table 4-85). From the Green River, 26 wells and 5 miles of road would be visible and audible, which is 15 and 3 more (respectively) than under the No Action Alternative (see Table 4-85). Although most development would be upriver (or north) of the Sand Wash put-in, three wells would be located downriver (or south) under this alternative. Four wells would be developed within 1 mile and 20 wells within 2 miles of the Sand Wash put-in under this alternative. Impacts to the recreational experience from increased noise levels and visual impacts would be the greatest under this alternative because there would be more wells developed near the Sand Wash put-in and more in the overall project area. It would be unlikely that the recreational experience at the Sand Wash Campground would be affected by the increase in noise levels from well development because the ambient noise levels are higher there than in the river corridor. Visual and noise impacts experienced on the stretch of the Green River north of the Sand Wash put-in would not affect as many visitors because recreational use is lower; however, because of the increased number of wells that would be developed, impacts to the recreational experience would be greater and of a longer duration.

Under this alternative there would be direct and indirect visual and noise impacts to the area considered under the Green River Management Plan because 2 wells are proposed within the boundary and 2 more within 1 mile of boundary. This alternative would likely require additional mitigation at the site-specific permitting stage to comply with management objectives stated in the 1979 plan. The implementation section of *Management Action #5 Suspend Oil and Gas Exploration* of the plan states the following: "Do not authorize requests for drilling within the previously mentioned river corridor (within sight or sound of the river)."

However, applicant-committed BMPs for the site-specific use where appropriate of buried pipelines and centralized water and condensate tank facilities would reduce the visual impacts of pipelines and tanks. In addition, river recreationists launching from the Sand Wash put-in would quickly move away from any sights and sounds of development.

4.8.1.3.4 Hunting

Big-game hunters would receive more long-term direct benefits from natural gas development in the project area under Alternative C, because there would be 526 miles of new roads, 454 more miles than under the No Action Alternative (see Table 4-83).

Alternative C would also result in more long-term indirect adverse impacts to big-game hunters related to elk and deer populations and behavior (see Section 4.16, Wildlife) because 7,442 acres of disturbance would occur from well pads and evaporation facilities construction, which is 5,987 more acres than under the No Action Alternative (see Table 4-83).

Constructing a network of new roads would result in loss of wildlife habitat, loss of forage (food) for wildlife, noise, and persistent human presence, which would negatively affect wildlife populations and use of the area. Increased road mileage would detract from the experience of hunters who value the experience of hunting in a natural setting removed from motorized sights and sounds.

4.8.1.3.5 OHV Recreation

Under Alternative C, OHV users would incur more direct long-term adverse impacts than under the No Action Alternative because more wells would be drilled, and therefore more areas that are currently designated for Limited OHV use would be altered by project activities and construction. Under Alternative C, where OHV uses are Limited, there would be a total of 8,442 acres of disturbance. This would be 6,908 more acres of disturbance when compared to the No Action Alternative. Under Alternative C, approximately 4.8% (within Limited OHV use areas) of land would be altered for OHV use, compared to 0.9% under the No Action Alternative (see Table 4-86). However, applicant-committed BMPs for the site-specific use where appropriate of buried pipelines would reduce the impacts of pipelines on OHV access.

OHV users would also gain more benefits under Alternative C than under the No Action Alternative because 319 more miles of new roads would be constructed under Alternative C (see Table 4-87).

4.8.1.3.6 Wetlands Recreation

Under Alternative C, approximately 4 acres of land within the border of the Pariette Wetlands ACEC would be converted from recreational use to natural gas development. By comparison, no disturbance within the border of the Pariette Wetlands would occur under the No Action Alternative (see Table 4-88). Mitigation measures for riparian areas are outlined in Section 4.15.2, Mitigation.

4.8.1.3.7 Hiking

Impacts to the wilderness therapy group Second Nature would increase under Alternative C compared to the No Action Alternative. There would be approximately 343 more wells, 84.1 more miles of new roads, and 1,734 more acres of total disturbance under Alternative C than under the No Action Alternative (see Table 4-89).

4.8.1.4 Alternative D: No Action

Under the No Action Alternative, impacts would occur to a lesser degree than under all other alternatives because the number of wells developed would be reduced to 368. Long-term adverse effects on recreation from the direct alteration of land for recreational use due to well-drilling facilities (well pads and evaporation facilities) would be less under the No Action Alternative than under all other alternatives because 1,455 acres of disturbance for well pads and evaporative facilities would occur, 4,425, 2,935, 5,897, 72, and 1,046 fewer acres than under the Proposed Action and Alternatives B, C, E, and F, respectively (see Table 4-83).

Noise impacts from each well constructed under the No Action Alternative would be the same as described under the Proposed Action (see Section 4.8.1.1). However, 1,123 less wells would be developed than under the Proposed Action so fewer recreation areas and recreationists would potentially be affected, and the duration of the temporary noise impacts would be shorter.

Long-term beneficial effects of additional recreational access would also decrease under the No Action Alternative compared to the action alternatives, because the expanded road network would be 325, 202, 454, 34, and 126 fewer miles than under the Proposed Action and Alternatives B, C, E, and F, respectively (see Table 4-83).

4.8.1.4.1 Nine Mile Canyon SRMA

Under the No Action Alternative, there would be the potential for 104 acres of disturbances (nearly 9 times fewer acres of surface disturbance than the under the Proposed Action) from construction of roads, pipelines, and well pads. Under this alternative, the percentage of the existing Nine Mile Canyon SRMA that would be disturbed for recreation would be 0.2% (see Table 4-84).

Under the No Action Alternative, six wells would be drilled in the less developed portion of the SRMA that currently provides opportunities for primitive recreation. There would be 35 acres of surface disturbance within the less developed portion of the SRMA related to construction of wells and other infrastructure. In addition, the noise and presence of people and machinery would intermittently and temporarily diminish opportunities for visitors to feel alone in an undeveloped setting on 4,779 acres, or 24% of this less developed portion of the SRMA—which would fall within 0.5 mile of areas that are directly disturbed. Natural gas development under the No Action Alternative would not segregate any of the area of the SRMA with primitive recreational opportunities into parcels smaller than 5,000 acres.

Approximately 5 miles of new roads total under the No Action Alternative would be available to recreationists (see Table 4-84). Under the No Action Alternative, the total length of roads in the Nine Mile Canyon SRMA would increase from 56 to 61 miles.

4.8.1.4.2 Vernal Extensive Recreation Management Area

Under the No Action Alternative, the effects natural gas development on the recreation activities, settings, and experiences of the undeveloped portion of the ERMA would be the same as described for Alternative A, but would affect far fewer areas and acreages of the ERMA. Under this alternative, 14 natural gas wells would be drilled in the portion of the ERMA (east and west of the Little Desert Road) that currently provides opportunities for primitive recreation. This would result in the direct surface disturbance of 82 acres. The presence and noise of people, vehicles, and equipment needed for construction and operation of the wells would reduce the opportunities for non-motorized and primitive forms of recreation currently available in this portion of the ERMA. Further, the noise and presence of people and machinery would intermittently and temporarily diminish opportunities for visitors to feel alone in an undeveloped setting on 9,700 acres, or 48% of this less developed portion of the ERMA—which would fall within 0.5 mile of areas that are directly disturbed. Development under the No Action Alternative would reduce opportunities for primitive recreation on 3,808 acres of the ERMA that would be segregated into parcels smaller than 5,000 acres.

4.8.1.4.3 River Recreation

Under the No Action Alternative, there would be no visual and noise impacts to river recreationists along Nine Mile Creek because no wells or roads would be visible from the floodplain. Visual impacts along the Green River would include 11 wells and 2 miles of new road (see Table 4-85). There would be no impacts to river recreationists from noise and visual intrusions from well development at the Sand Wash Campground, the Sand Wash put-in, and downriver because no wells would be developed within several miles of those locations. There would be some increases in large truck traffic along the Sand Wash and Wrinkle roads but it would be the least of all the alternatives. There would be visual and noise impacts to the river experience in the northernmost portion of the Green River corridor because of well development on state lands within 1 mile from the river. However, recreational use is minimal on this stretch of river. There would be no direct or indirect impacts to the area considered under the Green River Management Plan under this alternative because no wells are proposed within 2.5 miles of the boundary.

This alternative would have the same number of visible wells within the Green River viewshed as under Alternative A and 1 mile more of visible road. The impacts to the Nine Mile Creek viewshed would be the same (no wells or roads visible).

4.8.1.4.4 Hunting

Big-game hunters would receive fewer long-term direct benefits from natural gas development in the project area under the No Action Alternative because there would be 72 miles of new roads (see Table 4-83). However, the No Action Alternative would result in fewer long-term indirect adverse impacts to big-game hunters related to elk and deer populations and behavior (see Section 4.16, Wildlife), because 1,455 acres of disturbance would occur from well pads and evaporation facilities construction (see Table 4-83).

4.8.1.4.5 OHV Recreation

Under the No Action Alternative, OHV users would incur fewer direct long-term adverse impacts because fewer wells would be drilled and, therefore, fewer areas that are currently designated for Limited OHV use would be altered by project activities and construction. Under the No Action Alternative, approximately 1,534 acres (0.9%) of land within the proposed project area would be altered for OHV use (see Table 4-86).

OHV users would also receive fewer benefits under the No Action Alternative than under the Proposed Action because fewer miles of new roads (52 total miles of new roads under the No Action Alternative) would be constructed under the No Action Alternative (see Table 4-87).

4.8.1.4.6 Wetlands Recreation

Under the No Action Alternative, no acres of disturbance would occur within the border of the Pariette Wetlands ACEC (see Table 4-88). This alternative, therefore, would have no adverse impacts to wetlands recreationists.

4.8.1.4.7 Hiking

Impacts to the wilderness therapy group Second Nature would decrease under the No Action Alternative compared to the other alternatives. There would be approximately 15.9 miles of new roads, seven wells, and 450 acres of total disturbance under the No Action (see Table 4-89).

4.8.1.5 Alternative E: Reduced Development with Directional Drilling

Under Alternative E, 1,114 wells would be developed, 746 more than under the No Action Alternative. Well-pad locations would be precluded from some sensitive areas or occur at a lower density in those areas, and surface impacts would be reduced throughout the project area by developing multiple gas wells from each well pad. Long-term adverse effects on recreation from the direct alteration for well-drilling facilities (well pads and evaporation facilities) would be slightly increased (when compared to the No Action Alternative) under Alternative E, because 1,527 acres of disturbance for well pads and evaporative facilities would occur, 72 more acres than under the No Action Alternative (see Table 4-83). However, applicant-committed BMPs for the site-specific use where appropriate of buried pipelines and centralized water and condensate tank facilities would reduce the visual impacts of pipelines and tanks.

Noise impacts from each well constructed under Alternative E would be the same as described under the Proposed Action (see Section 4.8.1.1). However, 377 less wells would be developed than under the Proposed Action so fewer recreation areas and recreationists would potentially be affected, and the duration of the temporary noise impacts would be shorter.

Compared to the No Action Alternative, this alternative would have more potentially adverse impacts on recreational opportunities because 746 more wells would be developed and 72 more acres would be impacted by well pad and infrastructure construction. This would distract from the recreational experience to a greater degree than under the No Action Alternative because the development of more wells would create additional noise and would be of a longer duration.

Long-term beneficial effects on recreational access would increase under Alternative E compared to the No Action Alternative, because the expanded road network would be 106 miles, 34 more miles than the No Action Alternative (see Table 4-83). Overall, Alternative E would have slightly more adverse impacts to recreation from land alteration and noise, and more beneficial effects from an expanded road network than the No Action Alternative.

4.8.1.5.1 Nine Mile Canyon SRMA

Under Alternative E, 107 acres of surface disturbance would occur within Nine Mile Canyon SRMA. This is 3 more acres of surface disturbance than the 104 acres that would occur under the No Action Alternative. The percentage of the existing Nine Mile Canyon SRMA that would be disturbed for recreation would be 0.3% under Alternative E, which is the same under the No Action Alternative (see Table 4-84).

Under Alternative E, no wells would be drilled in the undeveloped portion of the SRMA that currently provides opportunities for primitive recreation. There would be, however, 17 acres of surface disturbance related to construction of infrastructure (i.e., roads and pipelines) associated with wells outside the undeveloped portion of the SRMA. Although natural gas development would physically disturbed very little of the less developed portion of the SRMA, the noise and presence of people and machinery would intermittently and temporarily diminish opportunities for visitors to feel alone in an undeveloped setting on 3,807 acres, or 19% of this less developed portion of the SRMA, which would fall within 0.5 mile of areas that are directly disturbed. Natural gas development under Alternative E would reduce opportunities for primitive recreation on 1 acre of the SRMA that would be segregated into parcels smaller than 5,000 acres.

Approximately 7 miles of new roads (2 more miles than under the No Action Alternative) would be available to recreationists under Alternative E. This represents an increased benefit to recreationists under Alternative E as compared to the No Action Alternative (see Table 4-84). Under Alternative E, the total length of roads in Nine Mile Canyon SRMA would increase from 56 to 63 miles.

4.8.1.5.2 Vernal Extensive Recreation Management Area

Under Alternative E, no natural gas wells would be drilled in the portion of the ERMA that is east and west of the Little Desert Road and that currently provides opportunities for primitive recreation. There would be, however, 4 acres of surface disturbance related to construction of infrastructure (i.e., roads and pipelines) associated with wells outside the undeveloped portion of the ERMA. The presence and noise of people, vehicles, and equipment needed for construction and operation of the wells would reduce the opportunities for non-motorized and primitive forms of recreation currently available in this portion of the ERMA. Further, the noise and presence of people and machinery would intermittently and temporarily diminish opportunities for visitors to feel alone in an undeveloped setting on 4,299 acres, or 21% of this less developed portion of the ERMA—which would fall within 0.5 mile of areas that are directly disturbed. Development under Alternative E would reduce opportunities for primitive recreation on 5 acres of the ERMA that would be segregated into parcels smaller than 5,000 acres.

4.8.1.5.3 River Recreation

Under Alternative E, there would be no visual and noise impacts to river recreationists along Nine Mile Creek because no wells or roads would be visible from the floodplain. Impacts visible from the Green River would include four wells and 1 mile of road, which is seven fewer wells and 1 fewer road mile than the No Action Alternative (see Table 4-85).

There are no wells proposed within 1 mile of the Sand Wash Campground and the Sand Wash put-in and only one well proposed within 2 miles under this alternative; therefore, impacts to the river experience would be expected to be minimal. However, there would still be impacts to recreationists traveling to the put-in via the Sand Wash and Wrinkle roads because of increases in large truck traffic. There would also be visual and noise impacts to the river experience in the northernmost portion of the Green River corridor because of well development on state lands that are within 1 mile from the river. However, recreational use is minimal on this stretch of river.

There would be no direct impacts to the area considered under the Green River Management Plan. However, the potential indirect effects from noise and visual intrusions near the Sand Wash put-in may require additional mitigation at the site-specific permiting stage to comply with management objectives stated in the 1979 plan. Under the implementation section of *Management Action # 5 Suspend Oil and Gas Exploration* of the plan it states the following: "Do not authorize requests for drilling within the previously mentioned river corridor (within sight or sound of the river)."

However, applicant-committed BMPs for the site-specific use where appropriate of buried pipelines and centralized water and condensate tank facilities would reduce the visual impacts of pipelines and tanks.

4.8.1.5.4 Hunting

Big-game hunters would receive more long-term direct benefits from natural gas development in the project area under Alternative E than under the No Action Alternative because there would be 106 miles of new roads, 34 more miles than under the No Action Alternative (see Table 4-83).

Alternative E would also result in more long-term indirect adverse impacts to big-game hunters related to elk and deer populations and behavior (see Section 4.16, Wildlife) because 1,527 acres of disturbance would occur, 72 more acres of disturbance than under the No Action Alternative (see Table 4-83).

Constructing a network of new roads would result in loss of wildlife habitat, loss of forage (food) for wildlife, noise, and persistent human presence, which would negatively affect wildlife populations and use of the area. Increased road mileage would detract from the experience of hunters who value the experience of hunting in a natural setting removed from motorized sights and sounds.

4.8.1.5.5 OHV Recreation

Under Alternative E, OHV users would incur slightly more direct long-term adverse impacts than under the No Action Alternative because more wells would be drilled, and therefore more areas that are within designated OHV Limited areas would be altered by development. Under Alternative E, there would be 203 more acres of disturbance in OHV Limited use areas under Alternative E compared to the No Action Alternative. Under Alternative E, approximately 1.0% of designated

Limited OHV areas would be altered within the project area, compared to 0.9% under the No Action Alternative (see Table 4-86). However, applicant-committed BMPs for the site-specific use where appropriate of buried pipelines would reduce the impacts of pipelines on OHV access.

OHV users would gain more long-term benefits under Alternative E than under the No Action Alternative because 83 miles of new roads would be constructed in OHV Limited areas under Alternative E (see Table 4-87) (31 more miles of potential OHV routes than under the No Action Alternative).

4.8.1.5.6 Wetlands Recreation

Under Alternative E, no acres of disturbance would occur within the border of the Pariette Wetlands ACEC. This alternative, therefore, would have no adverse impacts to wetlands recreationists (see Table 4-88).

4.8.1.5.7 Hiking

Impacts to members of the wilderness therapy group Second Nature would vary under Alternative E compared to the No Action Alternative. There would be 69 wells sited, 29 miles of new roads, and 460 acres of disturbance within a 3-mile radius of Wells Draw under Alternative E. This is seven fewer wells, 13.1 more miles of new roads, and 10 more acres of surface disturbance than under the No Action Alternative, which would result in 76 wells, 15.9 miles of new roads, and 450 total acres of surface disturbance within a 3-mile radius of Wells Draw (see Table 4-89). However, applicant-committed BMPs for the site-specific use where appropriate of buried pipelines and centralized water and condensate tank facilities would reduce the visual impacts of pipelines and tanks.

4.8.1.6 Alternative F: Agency Preferred Alternative

Under Alternative F, 1,298 wells would be developed. Well-pad locations would be precluded from some sensitive areas or occur at a lower density in those areas, and surface impacts would be reduced throughout the project area by developing multiple gas wells from some well pads. Long-term adverse effects on recreation from the direct alteration for well-drilling facilities (well pads and evaporation facilities) would be increased (when compared to the No Action Alternative) under Alternative F, because 2,501 acres of disturbance for well pads and evaporative facilities would occur, 1,046 more acres than under the No Action Alternative (see Table 4-83). However, applicant-committed BMPs for the site-specific use where appropriate of buried pipelines and centralized water and condensate tank facilities would reduce the visual impacts of pipelines and tanks.

Noise impacts from each well constructed under Alternative F would be the same as described under the Proposed Action (see Section 4.8.1.1). However, 193 less wells would be developed than under the Proposed Action so fewer recreation areas and recreationists would potentially be affected and the duration of the temporary noise impacts would be shorter.

Compared to the No Action Alternative, this alternative would have more potentially adverse impacts on recreational opportunities because 930 more wells would be developed and 1,046 more acres would be impacted by well-pad and infrastructure construction. This would distract from the recreational experience to a greater degree than under the No Action Alternative because the development of more wells would create additional noise and would be of a longer duration.

Long-term beneficial effects on recreation would also increase under Alternative F compared to the No Action Alternative, because the expanded road network would be 198 miles, 126 more miles than the No Action Alternative (see Table 4-83). Overall, Alternative F would have more adverse impacts to recreation from land alteration, and more beneficial effects from an expanded road network than the No Action Alternative.

4.8.1.6.1 Nine Mile Canyon SRMA

Under Alternative F, 491 acres of surface disturbance would occur within Nine Mile Canyon SRMA. This is 387 more acres of surface disturbance than the 104 acres than would occur under the No Action Alternative. The percentage of the existing Nine Mile Canyon SRMA that would be disturbed for recreation would be 1.1% under Alternative F, compared with 0.2% under the No Action Alternative (see Table 4-84).

Under Alternative F, 37 wells would be drilled in the undeveloped portion of the SRMA that currently provides opportunities for primitive recreation. Under this alternative, 226 acres of surface disturbance would occur from roads, pipelines, and well pads. This is 191 more acres than under the No Action Alternative. Although natural gas development would physically disturb very little of the less-developed portion of the SRMA, the noise and presence of people and machinery would intermittently and temporarily diminish opportunities for visitors to feel alone in an undeveloped setting on 9,742 acres, or 50% of this less-developed portion of the SRMA, which would fall within 0.5 mile of areas that are directly disturbed. Natural gas development under Alternative F would reduce opportunities for primitive recreation on 5,189 acres of the SRMA that would be segregated into parcels smaller than 5,000 acres.

Approximately 31 miles of new roads (26 more miles than under the No Action Alternative) would be available to recreationists under Alternative F. This represents an increased benefit to recreationists under Alternative F as compared to the No Action Alternative (see Table 4-84). Under Alternative F, the total length of roads in Nine Mile Canyon SRMA would increase from 56 to 87 miles.

4.8.1.6.2 Vernal Extensive Recreation Management Area

Under Alternative F, 59 natural gas wells would be drilled in the portion of the ERMA that is east and west of Little Desert Road and that currently provides opportunities for primitive recreation. This would result in the direct surface disturbance of 376 acres. The presence and noise of people, vehicles, and equipment needed for construction and operation of the wells would reduce the opportunities for non-motorized and primitive forms of recreation currently available in this portion of the ERMA. Further, the noise and presence of people and machinery would intermittently and temporarily diminish opportunities for visitors to feel alone in an undeveloped setting on 12,105 acres, or 59% of this less-developed portion of the ERMA—which would fall within 0.5 mile of areas that are directly disturbed. Development under Alternative F would reduce opportunities for primitive recreation on 5,245 acres of the ERMA that would be segregated into parcels smaller than 5,000 acres.

4.8.1.6.3 River Recreation

Under Alternative F, there would be no visual and noise impacts to river recreationists along Nine Mile Creek because no wells or roads would be visible from the floodplain. Impacts visible from the Green River would include 1 mile of road (no wells would be visible from the Green River viewshed), which is 1 less road mile than the No Action Alternative (see Table 4-85). Applicant-committed BMPs for the site-specific use where appropriate of buried pipelines and centralized water and condensate tank facilities would reduce the visual impacts of pipelines and tanks.

There are no wells proposed within 2 miles of the Sand Wash Campground and the Sand Wash put-in under this alternative; therefore, impacts to the river experience would be expected to be minimal. However, there would still be impacts to recreationists traveling to the put-in via the Sand Wash and Wrinkle Roads because of increases in large truck traffic. There would also be visual and noise impacts to the river experience in the northernmost portion of the Green River corridor because of well development on state lands that are within 1 mile from the river. However, recreational use is minimal on this stretch of river.

There would be no direct impacts to the area considered under the Green River Management Plan. However, the potential indirect effects from noise and visual intrusions near the Sand Wash put-in may require additional mitigation at the site-specific permitting stage to comply with management objectives stated in the 1979 plan. Under the implementation section of Management Action #5 Suspend Oil and Gas Exploration of the plan it states the following: "Do not authorize requests for drilling within the previously mentioned river corridor (within sight or sound of the river)."

4.8.1.6.4 Hunting

Big-game hunters would receive more long-term direct benefits from natural gas development in the project area under Alternative F than under the No Action Alternative because there would be 198 miles of new roads, 126 more miles than under the No Action Alternative (see Table 4-83).

Alternative F would also result in more long-term indirect adverse impacts to big-game hunters related to elk and deer populations and behavior (see Section 4.16, Wildlife) because 2,501 acres of disturbance from well pads and evaporation facilities would occur, 1,046 more acres of disturbance than under the No Action Alternative (see Table 4-83).

4.8.1.6.5 OHV Recreation

Under Alternative F, OHV users would incur more direct long-term adverse impacts than under the No Action Alternative because more wells would be drilled, and therefore more areas that are within designated OHV limited areas would be altered by development. Under Alternative F, there would be 1,444 more acres of disturbance in OHV limited use areas compared to the No Action Alternative. Approximately 1.7% of designated Limited OHV areas would be altered within the project area under Alternative F, compared to 0.9% under the No Action Alternative (see Table 4-86). Applicant-committed BMPs for the site-specific use where appropriate of buried pipelines would reduce the impacts of pipelines on OHV access.

OHV users would gain more long-term benefits under Alternative F than under the No Action Alternative because 162 miles of new roads would be constructed in OHV Limited areas (see Table 4-87, 110 more miles of potential OHV routes than under the No Action Alternative).

4.8.1.6.6 Wetlands Recreation

Under Alternative F, no acres of disturbance would occur within the border of the Pariette Wetlands ACEC. This alternative, therefore, would have no adverse impacts to wetlands recreationists (see Table 4-88).

4.8.1.6.7 HIKING

Impacts to members of the wilderness therapy group Second Nature would increase under Alternative F compared to the No Action Alternative. There would be 129 wells sited, 50 miles of new roads, and 819 acres of disturbance within a 3-mile radius of Wells Draw under Alternative F. This is 53 more wells, 34.1 more miles of new roads, and 369 more acres of surface disturbance than under the No Action Alternative, which would result in 76 wells, 15.9 miles of new roads, and 450 total acres of surface disturbance within a 3-mile radius of Wells Draw (see Table 4-89). However, applicant-committed BMPs for the site-specific use where appropriate of buried pipelines and centralized water and condensate tank facilities would reduce the visual impacts of pipelines and tanks.

4.8.2 MITIGATION

In addition to the applicant-committed measures detailed in Section 2.2.9, proposed measures to mitigate the impacts to recreational resources could include the following:

- Drivers would be instructed not to pick up hitchhikers or leave keys in vehicles.
- Low-profile tanks would be used to reduce visual impacts to recreationists at the direction of the AO.
- As feasible on a site-specific basis, off-site tanks or centralized tank batteries would be used at production locations to reduce visual impacts to recreationists.
- During the APD processing and as feasible, the Operator and AO would jointly determine the use of topographic features to serve as visual screens; place facilities away from highly visible points such as ridgelines; use low-profile tanks to reduce visibility where taller tanks would be more visible; use noise-reducing technology to reduce noise levels experienced by river recreationists to "quiet" levels; and avoid excessive side-casting of earth materials from ridgelines and steep slopes.

4.8.3 UNAVOIDABLE ADVERSE IMPACTS

Unavoidable adverse impacts to recreational resources include the long-term loss of primitive, dispersed, and unconfined recreational opportunities from surface-disturbing activities; increased vehicle traffic (see Section 4.5, Land Use and Transportation); adverse visual impacts (see Section 4.14, Visual Resources); and adverse noise impacts. Other unavoidable adverse impacts apply to specific groups of recreationists such as hunters, who would be impacted indirectly by direct impacts to big-game herds and game habitat fragmentation in the area (see Section 4.16, Wildlife) and members of the Second Nature therapy group, who would be directly impacted by disturbances within a 3-mile radius of Wells Draw on the bench above Nine Mile Canyon. In areas of concentrated natural gas development, change in natural settings would be an unavoidable long-term adverse impact to recreational resources, including visual impacts to river recreationists along the Green River and Nine Mile Creek.

4.8.4 IRRETRIEVABLE AND IRREVERSIBLE COMMITMENTS OF RESOURCES

Long-term impacts to recreational resources would be irretrievable until successful reclamation at the completion of natural gas development restored these resources. Irreversible impacts to recreational resources would include the alteration of natural settings where long-term development (i.e., roads) occurs and cannot be reclaimed (due to continued use or poor reclamation potential).

4.8.5 Relationship of Short-term Uses to Long-term Productivity

The short-term use of the project area for natural gas development would not impact long-term productivity of recreational resources because reclamation would restore the recreational values of the land. While permanent project-related roads (remaining after the completion of natural gas development) would alter these areas' suitability as use areas for non-motorized recreation, they would provide continued access to recreational opportunities for others, such as OHV users and hunters.

4.9 Socioeconomics

The development of wells and associated infrastructure under each of the alternatives would directly impact the social and economic resources of the project area due to its employment requirements, capital expenditures, and tax and royalty payments. Development and these direct impacts would also indirectly affect local housing availability, the population of Uintah and Duchesne counties, and the demand for social services in these areas. Social impacts are often discussed qualitatively because quantitative data are often not available to address these impacts. To the extent possible, economic impacts are quantified based on simplified assumptions and estimates of employment, production and revenue.

4.9.1 Direct and Indirect Effects

4.9.1.1 Alternative A: Proposed Action

4.9.1.1.1 Employment

The overall number of jobs available in the region surrounding the project area would be expected to increase as a result of the drilling of proposed wells. Based on Gasco's workforce requirements (Section 2.2.7, Table 2-4) of 1,644 worker days per well, the Proposed Action would employ approximately 224 people throughout the project life. Due to the proposed phased development of new wells, the increase in employment would not occur all at once, but would fluctuate over the 45-year life of the plan.

In addition, jobs in the mining, construction, and services industry would also increase. In large part, initial well construction draws temporary employees to the region. Local employees in the retail and service trades are required to meet the needs of the temporary workers. Once well construction is complete, temporary workers leave the project area and local employees are often hired to maintain wells. This suggests that mineral development boosts short-term employment levels but does not maintain similar long-term levels (BLM 2008b). The unemployment rate would be expected to temporarily decrease as additional jobs in industry and service become available, although some jobs may be filled from other employment sectors and by new workers who move to the area.

4.9.1.1.2 Population

Because Duchesne and Uintah counties have resource development–based economies, the Proposed Action would contribute to current population growth driven by the recent increase in oil and gas development. It is assumed that the population would increase proportionately to the number of wells that would be developed under each alternative. Similar to employment levels, population increases would fluctuate throughout the project life, with the highest increases in population occurring during the initial construction phase. As mentioned above, many oil/gas-related jobs are temporary, with some workers only required for a few months. Short-term employees are likely to stay in motels, apartments, and travel trailers on the job site, and would not contribute substantially to the local population.

4.9.1.1.3 Public Services and Infrastructure

Under the Proposed Action, an increase in population would increase the need for social services and infrastructure (BLM 2008b). Although the exact population increase cannot be accurately forecast, any population increase would be accompanied by a proportional increase in crime, fire, and demands on community resources. The counties are currently experiencing difficulties in keeping up with the demand on utilities and infrastructure. Advertisements are continually posted to maintain the infrastructure needs of the area, but there is simply not enough workforce to fill these positions (personal communication between Elisha Wardle, SWCA, and Tammy Ferguson, Uintah County Road Department, 2007). Because the Proposed Action proposes approximately 4 times more wells than the No Action Alternative, it would place proportionately more demands on the community infrastructure.

4.9.1.1.4 Public Costs and Revenue

According to the Utah Energy Office (UEO), the drilling and completion of a single gas well would result in beneficial impacts to local governments from services provided as well as tax and other revenue received. Sources for this revenue include general sales tax, individual and corporate income tax, employee retirement, and motor fuel sales tax. Expenditures include intergovernmental, education, transportation, health, police, fire, and corrections (UEO 2004). Table 4-90 shows the anticipated revenues and expenditures for the Uinta Basin area.

Table 4-90. Revenue and Expenditures per Well

Uinta Basin	
Local revenues	$42,200
Local expenditures	$14,000
Net local revenues	$28,200

Note: The UEO assumes a 100-well-per-year drilling and completion project. This is in line with the assumption for the project of 6–11 wells completed per month (or 70–130 per year).

Based on Table 4-90 and a total of 1,491 wells proposed under this alternative, net local revenue over the project life would total $42,046,200 to the combined Uintah County and Duchesne County economies. Table 4-91 illustrates the net local revenue per alternative.

Table 4-91. Revenue per Alternative

	Alternative A (Proposed Action)	Alternatives B (Reduced) and E (Directional)	Alternative C (Full)	Alternative D (No Action)	Alternative F (Agency Preferred)
Number of wells	1,491	1,114	1,887	368	1,298
Local revenue (millions)*	$42.0	$31.4	$53.2	$10.4	$36.6

*This assumes a net local revenue of $28,200 per well over the life of the well.

4.9.1.1.5 Development Costs

The cost to develop a single vertical well to a depth of approximately 12,000 feet below the surface is estimated at $1,456,999. Completion costs for a single straight well of the same depth is approximately $1,446,921. Therefore, the total estimated drilling and completion cost, including indirect costs such as earthwork, ROWs, etc., would be $2,903,920 per well under the Proposed Action.

4.9.1.1.6 Housing

The annual housing demand resulting from the Proposed Action would be greatest during the development phase of the project and decrease considerably during the long-term production phase as fewer workers are required to operate wells. Depending on the amount of oil and gas activity in the region that is occurring during the development phase, the existing housing may or may not accommodate the increased demand. In the early 2000s the housing market in the region was characterized by substantial increases in new single-family home construction, escalating prices, increasing numbers of manufactured housing and mobile home units. Short-term accommodations were being met through local campgrounds, hotels, and motels. The increase in hotel stays made it challenging to accommodate travelers and tourists at the height of the tourist season (personal communication between Elisha Wardle, SWCA, and Bill Johnson, Uintah County-Vernal City Economic Development, 2006). In short, the housing availability was very low in the early 2000's when oil and gas development was increasing.

In the wake of the national economic slowdown, housing availability in Uintah and Duchesne Counties has increased somewhat. Since the slowdown reduced the pace of oil and gas development and increased unemployment, an out-migration of workers has eased the demand for housing.

Thus, the incremental demand for housing as a result of the Proposed Action would have direct adverse impacts on housing and tourism accommodations if oil and gas development is booming. The demand for short-term housing for in-migrants would likely lead to increasing numbers of manufactured and mobile homes. The increase in demand would cause an increase in housing prices and negatively affect affordability.

Should the development occur when oil and gas development in the region is not at its peak, the supply of housing would be sufficient to meet the demand. Given the amount of housing development that occurred in the early 2000s and the out-migration of workers in the late 2000s, the in-migrants working on the Proposed Action would encounter housing availability and affordability.

4.9.1.1.7 Tourism and Recreation

Hotel availability is currently very limited in the Uinta Basin, driven primarily by increases in oil and gas activity and the associated increase in construction (personal communication between Elisha Wardle, SWCA, and Irene Hansen, Duchesne County Chamber of Commerce, 2006). Similarly, the high occupancy of RV parks is related to energy development because of the high number of oil and gas workers in the area. A tourism economy in the Uinta Basin cannot currently compete with the wealth and prosperity that is being achieved with oil and gas development. Tourism is currently promoted carefully in the area because the infrastructure is not sufficient to handle increased lodging demands (personal communication between Elisha

Wardle, SWCA, and Irene Hansen, Duchesne County Chamber of Commerce, 2006). Because the Proposed Action would create additional jobs and cause an increase in population, it would also contribute to the increased demand for hotels, thereby further out-competing tourism-related services in the Uinta Basin.

Wilderness therapy groups using the Wells Draw area would be adversely impacted under the Proposed Action. Approximately 1,192 acres of surface disturbance (from wells, pipelines and roads) within a 3-mile radius of Wells Draw would likely discourage the groups from using the area. Therapy groups would have to modify the location of their hiking trips, if possible, or discontinue use of the area altogether. (For current surface-disturbance acres and acreages per alternative and in the area, see Section 4.8.1.1.7, Table 4-89.) Should the wilderness therapy groups choose to relocate their overland hiking trips elsewhere in the Uinta Basin, economic contributions from the groups would remain similar to current conditions.

Under the Proposed Action, wells would be sited on the bench above Nine Mile Canyon. The presence of oil and gas development in close proximity to Nine Mile Canyon could lead to continued decreases in cultural and heritage tourism. Users of the canyon (e.g., Nine Mile Canyon Coalition) and the Castle Country Regional Information center have reported declines in visitor interest to the area that begun in 2004 (BLM 2010a). Visitors accessing Nine Mile Canyon from the north (Vernal area) would likely further decrease based on the increased presence of oil and gas development along Wells Draw, Sand Wash and Gate Canyon roads. The decrease in visitors accessing Nine Mile Canyon would continue throughout the life of the project. Reductions in visitors could represent a loss of revenue to cultural tour guides and loss of revenue for local businesses that serve visitors. There would also be a potential loss in non-market value to visitors discouraged from visiting Nine Mile Canyon as they perceive the cultural recreation experience is diminished as a result of the Proposed Action. However, visitors accessing Nine Mile Canyon through the Price area would not be adversely impacted by the Proposed Action as the travel route along Soldier Creek Road and views of Nine Mile Canyon would not be impacted by the Proposed Action.

Boaters accessing the Desolation Canyon put-in via Sand Wash Road would experience an increase in large truck traffic along the route to the river, as noted in Section 4.5, Land Use and Transportation. However, once boaters begin their river trip they would quickly escape the potential to experience the sights and sounds of the Proposed Action. Since the Proposed Action would occur to the north of the Desolation Canyon SRMA the impacts of the Proposed Action would not likely have an adverse impact on Desolation Canyon boaters. Therefore, a decrease in river running–related visitor spending is not anticipated. However, it should be noted that many people who choose to recreate in Desolation Canyon do so because of the high-value wilderness experience it offers. When these visitors experience the increase in oil and gas activity (truck traffic and well-pad construction and operations) leading to the put-in, a few recreationists may be discouraged from running the river in the future. But because the wilderness experience remains largely undisturbed once the recreationist is on the river, a decrease in river runners would be negligible.

Under the Proposed Action, the river runners who float the section of Green River immediately above the Sand Wash put-in would likely experience the sights and sounds of oil and gas development during periods when proposed well pads are being actively developed within 1 mile of the Green River. River runners who use the area for a primitive experience may be adversely impacted by the sights and sounds of the development and choose not to recreate on that stretch of river.

4.9.1.1.8 Environmental Justice

This section considers the potential direct and indirect environmental justice impacts that would result from the Proposed Action. For this analysis, applicable environmental justice guidance was applied to determine whether there could be a disproportionately high or adverse human health or environmental impact on low-income, minority or tribal populations near the Gasco project area as a result of the implementation of the Proposed Action or action alternatives.

Under many resources analyzed in the Final EIS, potential adverse impacts resulting from the Proposed Action or action alternatives would be site-specific to the project area. In these cases, environmental justice (EJ) communities would not be directly or indirectly impacted by changes to the project area. These resources are geology and minerals, paleontology, soils, special designations, special status species, vegetation, visual resources, water, wildlife, and wilderness characteristics. Thus, the only remaining resources that would be subject to adverse impacts as a result of the Proposed Action were evaluated for potential adverse impacts to EJ communities: air, climate, cultural, land use and transportation, livestock, recreation, and socioeconomics. Consideration as to whether the action alternatives would result in a disproportionate impact to EJ communities was given to these resources and a rationale has been provided in Table 4-92. . Resources for which the potential for disproportionate impacts on EJ communities necessitated consideration in greater detail are discussed below.

Table 4-92. Potential Environmental Justice Impacts Common to All Action Alternatives

Resources	Adverse Impact to EJ Communities?	Disproportionate Impact to EJ Communities?
Air	Yes	No. Near-field air quality monitoring indicates that oil and gas related pollutants would dissipate within 0.12–0.19 mile from the source and would not exceed National Ambient Air Quality Standards.
Climate	Yes	No. Impacts are regional in nature, not localized to EJ communities.
Cultural	Yes	No. Potential for disturbance to tribal-sensitive areas could affect the natural character of previously undisturbed areas through visual and auditory intrusions as well as through an increased risk of the physical disturbance of sites. However, impacts would be mitigated through the tribal consultation process and the PA.
Geology and Minerals	No. Impacts limited to project area	-
Land use and Transportation	Yes	No. Increases in project-related vehicle traffic would not go directly through the EJ communities of Myton , Randlett, Fort Duchesne, and Whiterocks, but would contribute to an overall increase in traffic on Highway 40. All frequent users of Highway 40 would be impacted equally, without a disproportionate effect on EJ communities.
Livestock Management	Yes	No. There is no indication that 743 AUMs (3.8% of total AUMs in the project area) impacted by the project are disproportionately operated by members of EJ communities.
Paleontological Resources	No. Impacts limited to project area	-
Recreation	Yes	No. Impacts to recreation would not be disproportionate to local communities.
Socioeconomics	Yes	No. As royalty revenues are dispersed to counties, the local communities would likely see beneficial economic impacts. As stated in Section 4.9.1, adverse impacts to population, employment, and housing would not likely disproportionately impact EJ communities. The workforce required to drill and complete wells would likely reside in more urban communities, given the proximity to services, and would not impact more rural EJ communities' population and or housing situation. The Proposed Action could result in direct and indirect jobs for members of EJ communities, thus having a beneficial impact on EJ community employment opportunities.
Soils	No. Impacts limited to project area	-

Table 4-92. Potential Environmental Justice Impacts Common to All Action Alternatives

Resources	Adverse Impact to EJ Communities?	Disproportionate Impact to EJ Communities?
Special Designations	No. Impacts would be felt by all individuals who visit special designation areas, not specific to EJ communities	-
Special Status Species	No. Impacts limited to project area	-
Vegetation	No. Impacts limited to project area	-
Visual Resources	No. Impacts to visual resource management (VRM) Class II areas won't be visible from EJ communities and visual impacts in and around the project area would be felt by all individuals not those specific to EJ communities	-
Water Resources	No. The proposed project would not impact community drinking water supplies, therefore impacts to water quality to in EJ communities would not be disproportionately impacted. With regard to water quantity, the proposed project would required withdrawal from public water supply, but water purchases are publicly available to all water users.	-
Wildlife	No. Loss of wildlife habitat and movement corridors are not directly connected to EJ populations because they are not dependent on wildlife.	-
Wilderness Characteristics	No. Loss of wilderness characteristics would be felt by all individuals, not just EJ communities.	-

4.9.1.1.8.1 Air Quality

Well-field development would occur approximately 12 miles south of the town Myton and the Randlett CDP; both are low-income and minority communities. Fort Duchesne and Whiterocks CDPs are located approximately 20 and 30 miles north of the project area, respectively. As disclosed in the *Greater Natural Buttes Supplement to the Draft EIS* (BLM 2011a), results of near-field air quality modeling indicate temporary short-term exceedances of the one hour NO_2 standard could occur under a scenario of multiple drilling rigs operating within a concentrated section of the project area. However, the concentrations of pollutants would dissipate within 200 to 300 meters (0.12 to 0.19 miles) of the source to below National Ambient Air Quality Standards (NAAQS) (BLM 2011b). Thus, near-field effects would not have an adverse impact on EJ communities located a minimum of 12 miles from the project area. These near-field effects are described in Section 4.2.1. Therefore, disproportionate adverse health impacts related to poor air quality in EJ communities near the Gasco project area are not likely.

4.9.1.1.8.2 Cultural

Activities associated with the Proposed Action have the potential to impact sites and resources of cultural, religious, and/or traditional importance to federally recognized Native American tribes with patrimonial claims to the lands within the project area. In the tribal-sensitive areas, construction and operation of wells and ancillary facilities could affect the natural character of previously undisturbed areas through visual and auditory intrusions as well as through an increased risk of the physical disturbance of sites. To address these potential direct and indirect effects of the Proposed Action on tribal-sensitive areas, Gasco, the BLM, and other state, federal, and local agencies have executed a PA outlining stipulations to be followed during construction and operation of the proposed facilities. The tribes were invited to be concurring parties in the PA. The measures stipulated in the PA will mitigate adverse effects on tribal-sensitive areas to levels such that disproportionate adverse impacts to tribal communities are not anticipated. For more information on the tribal consultation process, please see Chapter 5.0.

4.9.1.1.8.3 Land Use and Transportation

At the peak of construction and production, the Proposed Action would generate approximately 385 roundtrips per day across portions of the project area as well as on Highway 40 east of Myton. Increases in project-related vehicle traffic would not go directly through the EJ communities of Randlett, Fort Duchesne, and Whiterocks, but would contribute to an overall increase in traffic on Highway 40. Project traffic, prior to reaching the Sand Wash Road west of Myton, would be confined to Highway 40, the dominant transportation corridor through most of the communities in the Uinta Basin. Although Highway 40 runs through Myton, this is also true of other non-EJ communities like Vernal, Roosevelt, Duchesne, etc. Truck routes are currently signed in Myton, and heavy truck traffic warning signs are used by companies in accordance with UDOT rules. Highway 40 is the primary transportation route that links the EJ communities and other rural residents with services in Duchesne, Roosevelt, and Vernal. As noted in Transportation Section 4.5.1.1.2, the Proposed Action could increase the risk of traffic accidents by up to 139 accidents resulting in injuries and 329 property-damaging accidents over the 45-year lifespan of the Proposed Action. Members of the EJ communities, other Uinta Basin residents, and visitors who use the same transportation routes would all be subject to an increased probability of accidents given their close proximity to the project area and their dependence on the larger cities in the area for goods and services. Because EJ community members constitute a small proportion of all highway users and are similarly dependent on Highway 40 as a main transportation route as other residents and workers in the Uinta Basin, they would not be disproportionately affected by traffic increases.

4.9.1.1.8.4 Socioeconomics

As royalty revenues are disbursed from the state to Uintah and Duchesne Counties as a result of the Proposed Action, the EJ communities could see increased funding to support economic development and infrastructure improvements. An increase in direct (well producers and operators) and indirect employment opportunities (service jobs that support the oil and gas industry) for members of the EJ communities could be provided as a result of the Proposed Action. Thus, an increase in funding and employment opportunities would provide a beneficial economic impact to the EJ communities near the project area.

4.9.1.2 Alternative B: Reduced Development

Alternative B (Reduced Development) proposes 1,114 wells, which is approximately 3 times the number of wells under the No Action Alternative. This alternative would result in the creation of 167 industry-specific jobs throughout the project life. Jobs indirectly related to the drilling and production of Gasco's wells would also increase proportionately to meet the needs of the industry workers. Moderate short-term population growth would be likely under this alternative.

Revenue based on the production of 1,114 wells would result in $31.4 million for Uintah and Duchesne counties over the project life. Because the wells proposed under Alternative B would also be drilled vertically and to the same depth as under the Proposed Action, development and completion costs would be the same ($2.9 million per well), as would the gas price at which each well would result in a positive return on investment.

Adverse impacts to the housing market and hotel industry would be similar to the Proposed Action. Impacts to river runners, cultural heritage tourists, and wilderness therapy groups and their contribution to the local economy would be adverse under this alternative. Approximately 1,175 acres of land near Wells Draw would be disturbed with the development of roads, pipelines, and wells. This disturbance would likely deter groups from using the area.

In general, environmental justice impacts under Alternative B would be similar to those described in the Proposed Action. Slightly less truck traffic on Highway 40 would result in a reduced risk of traffic accidents and general disturbance to EJ communities in the area. Since Alternative B involves considerably less development, the potential economic benefits available to low-income populations under the Proposed Action would be proportionately reduced.

4.9.1.3 Alternative C: Full Development

Alternative C (Full Development) proposes 1,887 wells, which is approximately 5 times the number of wells as proposed under the No Action Alternative. This alternative would result in the creation of 283 industry-specific jobs throughout the project life. Jobs indirectly related to the drilling and production of Gasco's wells would also increase proportionately to meet the needs of the industry workers.

Revenue based on the production of 1,887 wells would result in $53.2 million for Uintah and Duchesne counties over the project life. Because the wells proposed under Alternative C would also be drilled vertically and to the same depth as under the Proposed Action, development and completion costs would be the same ($2.9 million per well), as would the gas price at which each well would result in a positive return on investment.

Adverse impacts to the housing market would be greatest under this alternative, as there would be even more demand for short-term accommodations. Adverse impacts to tourism, as it relates to hotel accommodations, would be greatest under this alternative. Adverse impacts to river runners, cultural heritage tourists, and wilderness therapy groups and their contribution to the local economy would also be greatest under this alternative. Approximately 2,184 acres of land near Wells Draw would be disturbed with the development of roads, pipelines and wells. This disturbance would likely deter groups from using this area.

In general, environmental justice impacts under Alternative C would be similar to those described in the Proposed Action. A 1.7% increase in truck traffic on Highway 40 would result in an increased risk of traffic accidents and general disturbance to EJ communities in the area. Since Alternative C involves considerably more development, the potential economic benefits available to low-income populations under the Proposed Action would be proportionately increased.

4.9.1.4 Alternative D: No Action

Under the No Action Alternative, impacts of well development such as construction, operational, and reclamation components would be the same as described for the Proposed Action; however, with 1,123 fewer wells than the Proposed Action, there would be 75% fewer jobs, personal income dollars, and revenue from well development to the area.

The No Action Alternative would result in the creation of 55 industry-specific jobs throughout the project life. Jobs indirectly related to the drilling and production of Gasco's wells would also increase proportionately to meet the needs of the industry workers.

Revenue based on the production of 368 wells would result in $10.7 million for Uintah and Duchesne counties over the project life. Because the wells proposed under Alternative B would also be drilled vertically and to the same depth as under the Proposed Action, development and completion costs would be the same ($2.9 million per well); as would the gas price at which each well would result in a positive return on investment.

The No Action Alternative would have the least amount of adverse impacts to the presently constrained housing market and tourism industry. Surface disturbance in the Wells Draw area would be doubled from the current conditions (with an anticipated 450 acres disturbed), and would likely have an adverse impact on those using the area for wilderness therapy purposes.

In general, environmental justice impacts under all alternative would be similar to those described in the Proposed Action. Less truck traffic on Highway 40 would result in a reduced risk of traffic accidents and general disturbance to EJ communities in the area. Since the No Action Alternative involves considerably less development, the potential economic benefits available to low-income populations under the Proposed Action would be proportionately reduced.

4.9.1.5 Alternative E: Reduced Development with Directional Drilling

Alternative E proposes same number of wells as Alternative B (1,114, approximately 3 times the number of wells under the No Action Alternative); therefore, Alternative E would result in similar industry-related employment levels, royalties, and state and local revenues as Alternative B.

Alternative E avoids many of the same natural resources accessed by recreation groups (undeveloped portions of the Nine Mile Canyon SRMA and Vernal ERMA, non-Wilderness Study Area [WSA] lands with wilderness characteristics, river corridors, etc.); therefore, impacts to river runners, cultural heritage tourists, and other recreationists would be less than the Proposed Action but greater than the No Action Alternative, Approximately 460 acres of land near Wells Draw would be disturbed with the development of roads, pipelines, and wells. This disturbance would likely deter wilderness therapy groups from using this area.

Directional drilling would require an increase in development and completion costs in comparison to the drilling of a straight vertical wells, as proposed under the other alternatives. The development costs of drilling a single well at 20-acre spacing offset to 12,000 feet would be approximately $1,721,951. Completion costs for the well would be approximately $1,461,195 making the total well cost of a single well approximately $3,183,146.

The cost of drilling a single well at a 40-acre spacing offset to the same depth would be $2,037,528. Completion costs are estimated at $1,463,213, making the total well cost of a single well $3,500,741. Development costs for a single well at a 160-acre spacing offset and the same depth would be $2,531,207. Completion costs for the well would be approximately $1,471,138, making the total cost of a single well approximately $4,002,344.

Due to the higher cost of drilling a single well, the range of economic conditions under which this alternative would result in a return on investment would be narrower than under any other alternative. Environmental justice impacts would be similar to those described under the Proposed Action.

4.9.1.6 Alternative F: Agency Preferred Alternative

Impacts to socioeconomics from Alternative F would be similar to impacts associated with Alternative E. Because Alternative F proposes 184 more wells (1,298), it would result in slightly increased industry related employment levels (195 industry specific jobs throughout the project life), royalties, and state and local revenues. Alternative F avoids many the same natural resources accessed by recreation groups (undeveloped portions of the Nine Mile Canyon SRMA and Vernal ERMA, non-WSA lands with wilderness characteristics, river corridors, etc., therefore, impacts to river runners, cultural heritage tourists, wilderness therapy groups, and the local community would be similar to Alternative E but greater than the No Action Alternative. Approximately 819 acres of land near Wells Draw would be disturbed with the development of roads, pipelines, and wells. This disturbance would likely deter groups from using this area.

This alternative includes both directional drilling to reduce surface impacts and vertical drilling. For wells drilled vertically to the same depth as under the Proposed Action, development and completion costs would be the same as the Proposed Action ($2.9 million per well).

Directional drilling would require an increase in development and completion costs in comparison to the drilling of straight vertical wells, as proposed under Alternatives A, B, C, and D. The development costs of drilling a single well at 20-acre spacing offset to 12,000 feet would be approximately $1,721,951. Completion costs for the well would be approximately $1,461,195 making the total well cost of a single well approximately $3,183,146.

The cost of drilling a single well at a 40-acre spacing offset to the same depth would be $2,037,528. Completion costs are estimated at $1,463,213, making the total well cost of a single well $3,500,741. Development costs for a single well at a 160-acre spacing offset and the same depth would be $2,531,207. Completion costs for the well would be approximately $1,471,138, making the total cost of a single well approximately $4,002,344.

The range of economic conditions under which this alternative would result in a return on investment would be narrower than Alternatives A, B, C, and D. However, the combination of vertical and directional drilling could make the project more feasible under certain economic conditions than Alternative E.

In general, environmental justice impacts under the Alternatives would be similar to those described in the Proposed Action. However, because Alternative F involves less development and associated surface disturbance than the Proposed Action, the potential for disturbance to tribal religious, cultural sites, and ways of life would be decreased. Less truck traffic on Highway 40 would result in a reduced risk of traffic accidents and general disturbance to EJ communities in the area. Since Alternative F involves considerably less development, the potential economic benefits available to low-income populations under the Proposed Action would be proportionately reduced.

4.9.2 Mitigation

Tribal consultation is ongoing for areas where conflicts arise between traditional tribal values and practices. See Chapter 5.0 and the PA (Appendix Q) for more information on the tribal consultation and mitigation measures in place to address tribal concerns.

4.9.3 Unavoidable Adverse Impacts

Given that natural resource development is finite and based on demand, the Uinta Basin is susceptible to a boom-and-bust cycle. While the proposed development would temporarily have positive impacts on the local economy, the depletion of the resource would result in an adverse impact to the economy. Those who had been dependent on the jobs and revenue provided by the project would be adversely impacted. Typically, the “bust” portion of the economic cycle adversely impacts nearly every sector of the economy, including employment/unemployment, housing, population, poverty rates, public finances, and infrastructure.

4.9.4 Irretrievable and Irreversible Commitments of Resources

The extraction of oil and gas would result in a permanent loss of natural resources. The irretrievable loss of oil and gas would preclude future revenues for local, state, and federal governments and the local communities.

4.9.5 RELATIONSHIP OF SHORT-TERM USES TO LONG-TERM PRODUCTIVITY

Increases in the workforce would contribute to temporary increases in income, housing, and service requirements. The increase in employment and revenues resulting from the proposed development would have short-term benefits for the local communities. However, once the project is complete, local revenues would be reduced and jobs would be eliminated or redirected.

4.10 SOILS

All of the alternatives would impact soil resources within the project area through surface disturbance associated with road building, pipeline construction, well drilling, and well-pad development. These activities would impact soils to varying degrees depending on the amount, placement, and type of surface disturbance; the disturbed soil's characteristics; and the surface hydrology. Impacts include the removal of vegetation, exposure of the soil, mixing of soil horizons, soil compaction, loss of topsoil productivity, and increased susceptibility of the soil to wind and water erosion. Blading or excavation on slopes to achieve desired grades could result in slope-steepening of exposed soils on cut and fill slopes, thereby increasing the risk of slope failures.

For the purposes of this broad-scale analysis, the primary basis of describing impacts to soils is the amount of surface disturbance caused by the construction of wells, pipelines, roads, evaporative facilities, and ancillary infrastructure, particularly surface disturbance that occurs in highly erodible, reclamation-limited, or other sensitive soils.

Throughout this analysis, highly erodible soils, reclamation-limited soils, and biological soil crusts are collectively referred to as sensitive soils. Biological soil crusts are discussed only qualitatively and are not included in the tables. However, any of the other soil parameters may overlap in any area, and therefore acreages presented in this analysis are not additive. For example, a particular acreage may have soils with shallow rooting depth as well as high wind erodibility. Acreages are also only approximate, due to limitations in soil mapping techniques and the planning area–wide scale of analysis.

4.10.1 DIRECT AND INDIRECT EFFECTS

4.10.1.1 ALTERNATIVE A: PROPOSED ACTION

4.10.1.1.1 REHABILITATION POTENTIAL

Project activities under the Proposed Action would impact approximately 7,584 acres of soils, many of which have features that limit the disturbed area's rehabilitation potential following disturbance. Table 4-93 displays the acreage of rehabilitation-restrictive soil features that would be disturbed under each alternative, as well as percentages of the total disturbed soil. Some soil limitation areas overlap; therefore, the acreages listed in this table total more than the number of acres that would be disturbed in the project area.

Table 4-93. Acres of Rehabilitation Restrictive Soil Features Disturbed under Each Alternative

Restrictive Feature	Degree of Restriction	Acres Disturbed and Percentage of Total Area Disturbed Where Restrictive Feature is Present					
		Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Water Erosion Hazard	Highly restrictive	10 (0.1%)	9 (0.2%)	8 (0.1%)	3 (0.1%)	1 (0.0%)	7 (0.2%)
	Moderately restrictive	20 (0.3%)	19 (0.3%)	30 (0.3%)	7 (0.3%)	1 (0.0%)	15 (0.4%)
	Total	30 (0.4%)	28 (0.5%)	37 (0.4%)	10 (0.5%)	1 (0.1%)	22 (0.6%)
Wind Erosion Hazard	Highly restrictive	0 (0.0%)	2 (0.0%)	14 (0.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
	Moderately restrictive	1,225 (16.2%)	809 (14.2%)	1,841 (18.4%)	545 (26.5%)	418 (19.2%)	430 (12.0%)
	Total	1,225 (16.2%)	811 (14.3%)	1,855 (18.6%)	545 (26.5%)	418 (19.2%)	430 (12.0%)
Excess Salt	Highly restrictive	165 (2.2%)	111 (1.9%)	213 (2.1%)	33 (1.6%)	43 (2.0%)	77 (2.1%)
	Moderately restrictive	382 (5.0%)	183 (3.2%)	468 (4.7%)	101 (4.9%)	64 (2.9%)	69 (1.9%)
	Total	547 (7.2%)	294 (5.2%)	682 (6.8%)	134 (6.5%)	107 (4.9%)	146 (4.0%)
Excess Sodium	Highly restrictive	2,081 (27.4%)	1,418 (24.9%)	2,243 (22.5%)	552 (26.9%)	576 (26.5%)	838 (23.3%)
	Moderately restrictive	3,551 (46.8%)	2,825 (49.7%)	5,332 (53.4%)	1,211 (58.9%)	1004 (46.2%)	1,494 (41.6%)
	Total	5,632 (74.3%)	4,243 (74.6%)	7,575 (75.9%)	1,763 (85.8%)	1580 (72.7%)	2,332 (64.9%)
Alkaline Soils	Highly restrictive	1,844 (24.3%)	1,418 (24.9%)	2,243 (22.5%)	552 (26.9%)	498 (22.9%)	652 (18.1%)
	Moderately restrictive	3,944 (52.0%)	2,825 (49.7%)	5,332 (53.4%)	1,211 (58.9%)	1135 (52.2%)	1,769 (49.2%)
	Total	5,788 (76.3%)	4,243 (74.6%)	7,575 (75.9%)	1,763 (85.8%)	1633 (75.1%)	2,421 (67.3%)
Rooting Depth	Highly restrictive	2,198 (29.0%)	1,473 (25.9%)	3,489 (35.0%)	844 (41.1%)	673 (31.0%)	888 (24.7%)
	Moderately restrictive	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
	Total	2,198 (29.0%)	1,473 (25.9%)	3,489 (35.0%)	844 (41.1%)	673 (31.0%)	888 (24.7%)

Table 4-93. Acres of Rehabilitation Restrictive Soil Features Disturbed under Each Alternative

Restrictive Feature	Degree of Restriction	Acres Disturbed and Percentage of Total Area Disturbed Where Restrictive Feature is Present					
		Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Droughty Soils	Highly restrictive	2,685 (35.4%)	1,951 (34.3%)	3,599 (36.1%)	666 (32.4%)	705 (32.4%)	1,234 (34.3%)
	Moderately restrictive	1,521 (20.1%)	1,277 (22.5%)	1,723 (17.3%)	474 (23.1%)	438 (20.1%)	529 (14.7%)
	Total	4,206 (55.5%)	3,228 (56.8%)	5,322 (53.3%)	1,140 (55.5%)	1143 (52.6%)	1,763 (49.0%)
Reclamation Potential	Highly restrictive	3,673 (48.4%)	2,620 (46.1%)	4,883 (48.9%)	1,179 (57.4%)	1071 (49.3%)	1,438 (40.0%)

Note: See Table 3-23 for ranges of parameters used to define degrees of restriction to rehabilitation. Draft parameters were developed by the BLM's National Science and Technology Center, utilizing SSURGO soils mapping.

Under the Proposed Action, at least 75% of the 7,584 acres of soils that would be disturbed in the project area have at least one limiting factor (see Table 4-93). Adverse impacts that result from disturbing these sensitive soils are degradation of soil productivity, structure, and texture; erosion; and sedimentation of surface waters. Surface disturbance under the Proposed Action would impact approximately 3.7 times the area of soils impacted under the No Action Alternative. Therefore, the Proposed Action has a greater potential for adverse impacts to sensitive soils, because erodible, reclamation-limited, and biological crusted soils would have larger areas disturbed by mineral development under this alternative (see Table 4-93).

Approximately 48% to 76% of the total disturbance under the Proposed Action would occur in soils that are “highly restrictive” or “moderately restrictive” for high excess sodium, alkalinity, droughty conditions, or poor reclamation potential (a metric that combines alkalinity and salinity) (see Table 4-93). Approximately 29% of the total disturbance under this alternative would occur in soils with highly to moderately restrictive rooting depths, and 16% would occur in soils with moderately restrictive wind erosion potential. Because the Proposed Action would impact a larger area of soils, it would also affect more reclamation-limited soils than the No Action Alternative.

This general unsuitability of the project area's soils to rehabilitation would have long-term negative impacts to soil productivity and soil erosion rates in areas disturbed by the Proposed Action. Enhanced erosion rates and decreased soil-infiltration capacity, particularly of highly saline soils, would potentially impact water quality in the area by increasing sediment and salt concentrations. (These effects are described in greater detail in Section 4.15, Water Resources.) Revegetation of disturbed soils would be of limited success in areas with rehabilitation-restricted soils, leading to a net loss of native vegetation and an increase in invasive species (a process described in Section 4.13, Vegetation). Because it generally takes at least 10 years to reclaim a site following disturbance (based on BLM experience in the project area), impacts related to vegetation removal would persist as long-term impacts.

4.10.1.1.2 Biological Soil Crusts

Biological soil crusts (cryptobiotic soils) are not included in Table 4-93, although crusts have similar restrictions regarding rehabilitation as those soil features that are included. Surface disturbance and soil stockpiling associated with project construction could remove biologically active soil crusts throughout the development area. No data exist on the distribution of biological soil crusts in the project area; however, the highest likelihood for biological soil crust occurrence is under sagebrush (71,312 acres) and pinyon-juniper woodland (39,821 acres) communities, which occur on a total of approximately 54% of the Proposed Action area. A total of 1,143 acres of pinyon-juniper woodland and shrubland would be disturbed under the Proposed Action (or 15% of all disturbance), and 3,028 acres of sagebrush community types would be disturbed (or 40% of all disturbance) (Table 4-94). Because these soil surface communities recolonize and regrow very slowly where disturbed, the soil-stabilization, nitrogen-fixing, and carbon-fixing benefits these communities provide would be lost for up to 250 years (USGS 2002). Drought could further extend this recolonization period by aggravating wind erosion and limiting water available to cyanobacteria, moss, and fungi (BLM 2001). This alternative would therefore have a greater risk of impacting biological soils crusts than the No Action Alternative, because it would impact approximately 4.6 times more area dominated by sagebrush communities, and 4.1 times more area dominated by pinyon-juniper woodland communities—both of which are associated with soil crusts (see Table 4-94).

Table 4-94. Surface Disturbance within Vegetation Communities Associated with Biological Soil Crusts

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Acres (and %) surface disturbance in sagebrush communities	3,028 (40%)	2,123 (37%)	3,535 (35%)	652 (32%)	776 (38%)	1,508 (42%)
Acres (and %) surface disturbance in pinyon-juniper woodland communities	1,143 (15%)	974 (17%)	1,717 (17%)	278 (14%)	126 (6%)	706 (20%)

4.10.1.1.3 Erosion and Sediment Yield

An increased sediment yield is a potential indirect effect of enhanced erosion rates following vegetation removal, soil exposure, and steepening of exposed soils during road and well-site construction. Typically, well-pad construction results in a cut slope, a level well pad, and a fill slope. Cut slopes would typically be bare of vegetation and steeper than the surrounding slope, increasing sediment yields. The sediment from the cut slopes would be deposited on the well-pad site. Because they are typically steeper, less consolidated, and devoid of vegetation, fill slopes would also increase sediment yields; their sediment being delivered to the area adjacent to the fill slopes. Removal of 7,584 acres of vegetation (3.7 times more than that removed under the No Action Alternative) would increase the potential for channelized runoff and accelerated erosion to occur, with a corresponding increase in rill and gully erosion where disturbance occurs on steeper slopes. Where well-pad facilities are located in active drainages and protective streambank vegetation is removed, there would be an increase in the vulnerability of the streambanks to lateral widening, resulting in an increase in sediment loads in the particular drainage. As sediment loads are increased within drainages, the potential for deposition, braiding, and lateral bank widening is increased, which can lead to a cycle of repeating deposition, braiding, and lateral bank widening downstream.

Additional roads would indirectly impact soils by providing additional OHV access and use in previously remote areas. These OHV impacts would be concentrated adjacent to the 325 miles of new roads that would be constructed under this alternative. Areas where OHV use was increased would experience additional soil compaction and surface abrasion. This alternative would result in the construction of 4.5 times as many miles of new access road as under the No Action Alternative.

Construction on slopes greater than 30% is expected to take place on approximately 839 acres, or approximately 11% of the total acres disturbed during construction. Construction on slopes greater than 40% is expected to take place on approximately 452 acres, or approximately 6% of the total acres disturbed during construction (Table 4-95). This is approximately 5.7 times as large an area of construction on 30% slopes, and 7.3 times as large an area on 40% slopes, as would occur under the No Action Alternative. Construction of well pads and roads on slopes greater than 40% generally require extensive cuts and fills, which can have the following results:

- Greater erosion potential from a large scar
- Greater potential to lose, mix, or bury critical topsoil during construction and reclamation, which would lower long-term soil productivity
- Greater difficulty in stabilizing cut slopes via revegetation (most soils on these slopes have greater than 35% coarse fragments, which greatly lowers the reclamation potential)
- Greater difficulty in returning disturbed slopes to their preconstruction contour during final reclamation

Table 4-95. Surface Disturbance of Slopes Greater than 30% and 40% under Each Alternative

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Surface disturbance on slopes >30% (acres)	839	603	1,125	148	209	215
Percentage of surface disturbance under alternative that would occur on slopes >30%	11%	11%	11%	7%	10%	6.0%
Surface disturbance on slopes >40% (acres)	452	276	605	62	93	221
Percentage of surface disturbance under alternative that would occur on slopes >40%	6%	5%	6%	3%	4%	6.1%

Soils in the project area on steep slopes generally have low infiltration/high runoff values. These same soils also have a moderate or high hazard of water erosion, which would be further aggravated by increased runoff from roads and well pads. Although locations were assumed for the purpose of analysis, potential roads and well pads were not specifically sited on a map. These locations would be determined at the time of the application, and analyzed through site-specific NEPA analysis.

Current erosion-modeling techniques (e.g., RUSLE, WEPP, Crossdrain) require site-specific data such as road length, soil texture, length between drainage dips, etc., and are therefore not practicable at this programmatic level of analysis. Therefore, the following assumptions were made to calculate soil losses from the drilling of 1,491 wells in the Proposed Action:

- Sediment yields were calculated assuming an average background value of 2.2 tons/acre/year. Erosion rates were estimated to be 3 times the average background rate of 2.2 tons/acre/year for the first year following disturbance (for a net increase of 4.4 tons/acre/year). They would be double the background rate thereafter for the life of the facility (for a net increase of 2.2 tons/acre/year). These figures are based on BLM professional judgment and experience with soil erosion in the project area.
- Disturbance per developed well was assumed to be 3.8 acres for the well pad, and 0.9 acres for each access road to the well pad. Total new disturbance per well would therefore be 4.7 acres.
- Based on previous reclamation efforts in the project area, it is assumed that stabilization of disturbed areas usually takes an average of 4 years following reclamation, with the longer time spans on the rockier, shallower soils of hill slopes and shorter on the finer textured soils of valley bottoms. Therefore, a four-year time span following reclamation/reseeding was used in the sediment yield calculations.

Based on these assumptions, each well development would contribute an additional 20.7 tons/year of soil loss the first year following disturbance (4.4 tons/acre × 4.7 acres). Each well development would create an additional 10.3 tons/year for the remaining 29 years of the expected 30-year development life (4.7 acres × 2.2 tons/acre).

At the end of 30 years, the well and access road would be reclaimed, and an additional 10.3 tons/year of sediment would continue to be produced for four years after reclamation, until the disturbed sites are stabilized (4.7 acres × 2.2 tons/acre).

Using the assumptions above, the total sediment produced above background rates per well is calculated below.

Year 1	20.7 tons
Years 2–29	10.3 tons/year × 29 years = 299.9 tons
Years 30–34	10.3 tons/year × 4 years = 41.4 tons

Total produced sediment for each well development for a span of 34 years would be approximately 362 tons. If evenly distributed over each disturbed surface, this equates to the erosion of approximately 0.45 inches of soil. With 1,491 wells proposed for development, approximately 539,593 tons of sediment would be produced over the life of the project (Table 4-96). This is approximately 4.1 times more excess sediment than would be produced under the No Action Alternative.

Table 4-96. Estimated Sediment Erosion and Delivery under Each Alternative

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Number of well pads proposed	1,491	1,114	1,887	368	328	575
Estimated tons sediment erosion (above background erosion)	539,593	531,797	682,905	133,179	136,382*	239,085*
Estimated tons of sediment delivered to drainages	107,919	106,359	136,581	26,636	27,276*	47,817*

*Note that slightly different assumptions were used for Alternative E and F, as described in Sections 4.10.1.5.3 and 4.10.1.6.3.

Where soil is delivered to a stream channel within a drainage network, sediment delivery efficiency is increased. Sediment delivery outside of defined channels is inefficient. Consequently, the majority of the sediment from the proposed wells is expected to be deposited onto adjacent undisturbed areas. Sediment produced from roads is much more efficiently delivered to drainages, depending upon the location of the road. Of the estimated sediment yield production of 539,593 tons, an estimated 20% of this amount (based on BLM experience in the project area), or 107,919 tons would be delivered to the network of ephemeral drainages. Once delivered to an ephemeral drainage, the sediment would be available for transport. Over time, a large proportion of this sediment would likely be delivered to the Green River. However, because this would represent a very small increase to the approximately 2.2 million tons of sediment carried by the Green River each year (BLM 2007a), it is unlikely that there would be more than a slight incremental impact to sedimentation along the Green River.

Additional erosion would occur where water is collected along a road and then turned off into adjacent drainages. Past experience indicates that if water is diverted toward a drainage on roads within 20 feet of that drainage, headcutting will result in water trending back toward the road. This is because most of the drainages have vertical banks, the gradient between the roadbed elevation and the drainage bed is quite steep, and there is little perennial vegetation to decrease overland flows. In some instances the headcut is eroding into the roadbed, and working up the borrow ditch. Because each water turnout site would have varying parameters (such as the drainage depth, area of water collection, etc.), the amount of erosion is difficult to estimate and can only be determined in the field. The expected bank erosion would result in localized areas of deposition in the drainage; however, the total amount of deposition is not expected to result in any extensive aggradation, braiding, or lateral stream bank widening in any one watershed.

Gathering pipelines associated with the well development would primarily be surface lines made of steel. Experience with surface lines elsewhere in the Uinta Basin has shown that there are typically minor amounts of surface disturbance involved with surface-line installation (BLM 1999a). Installation and construction of surface lines in the project area would not be expected to cause a measurable increase in erosion or sediment yield.

4.10.1.2 Alternative B: Reduced Development

Under this alternative, impacts to soil resources would be of the same nature as described for the Proposed Action. However, they would be of lesser magnitude and affect fewer acres. Well-pad locations would be precluded from some sensitive areas, and the number of wells developed would be reduced to 1,114. This alternative would impact approximately 5,685 acres of soil resources, or approximately 2.8 times the area of soils impacted under the No Action Alternative.

4.10.1.2.1 Rehabilitation Potential

A smaller area of rehabilitation-restricted soils would be impacted under this alternative than under the Proposed Action, as shown in Table 4-93. As with the Proposed Action, site rehabilitation following this alternative's actions would be most limited by soils with excess sodium, alkalinity, droughty conditions, and poor reclamation potential. Each of these conditions occurs at the "highly restrictive" or "moderately restrictive" level over 46% to 75% of the area that would be disturbed under Alternative B (see Table 4-93). Highly to moderately restrictive rooting depths would affect 26% of the 5,685 acres of soil disturbance under this alternative, and moderately restrictive wind erosion potential would affect 14% of the disturbed area. Because Alternative B would impact 2.8 times the area of soils that would be impacted under the No Action Alternative (with a similar occurrence of restrictive features), it would also affect more reclamation-limited soils than would be affected under the No Action Alternative.

4.10.1.2.2 Biological Soil Crusts

This alternative would result in approximately 5,685 acres of surface disturbance, or 3.8 times the area of disturbance that would result under the No Action Alternative. Because the distribution of biological soil crusts in the area is unknown, an increase/decrease in surface disturbance is assumed to correspond to a similar increase/decrease in impacts to soil crusts. A total of 974 acres of pinyon-juniper woodland and 2,123 acres of sagebrush community types would be disturbed under this alternative. This alternative would therefore pose a greater risk of impacting biological soils crusts than the No Action Alternative, because it would impact approximately 3.3 times more area dominated by sagebrush communities, and 3.5 times more area dominated by pinyon-juniper woodland communities, both of which are associated with soil crusts (see Table 4-94).

4.10.1.2.3 Erosion and Sediment Yield

Removal of 5,680 acres of vegetation (2.8 times more than under the No Action Alternative) would increase the potential for channelized runoff and accelerated erosion to occur, with a corresponding increase in rill and gully erosion where disturbance occurs on steeper slopes. Construction on slopes greater than 30% is expected to take place on approximately 603 acres, or approximately 11% of the total acres disturbed during construction. Construction on slopes greater than 40% is expected to take place on approximately 276 acres, or approximately 5% of the total acres disturbed during construction (see Table 4-95). This is approximately 4.1 times as large an area of construction on 30% slopes, and 4.4 times as large an area on 40% slopes, as would occur under the No Action Alternative.

Increased soil erosion would generate an estimated 531,797 tons of sediment over the life of the project under this alternative, of which an estimated 106,359 tons would be delivered to active drainages that are tributary to the Green River (see Table 4-96). This is approximately 3.0 times more excess sediment than would be produced under the No Action Alternative. The assumptions used to calculate soil losses are the same as described under the Proposed Action.

4.10.1.3 Alternative C: Full Development

Under Alternative C (Full Development), impacts to soil resources would be of the same nature as described for the Proposed Action. However, they would be of greater magnitude and affect more acres. Well pads would be located in additional areas and the number of wells developed would be increased to 1,887. This alternative would impact approximately 9,982 acres of soil resources, or approximately 4.9 times as large an area of soils as under the No Action Alternative.

4.10.1.3.1 Rehabilitation Potential

A larger area of rehabilitation-restricted soils would be impacted under this alternative than under the Proposed Action, as shown in Table 4-93. As under the Proposed Action, site rehabilitation following this alternative's actions would be most limited by soils with excess sodium, alkalinity, droughty conditions, and poor reclamation potential. Each of these conditions occurs at the "highly restrictive" or "moderately restrictive" level over 49% to 76% of the area that would be disturbed under Alternative C (see Table 4-93). Highly to moderately restrictive rooting depths would affect 35% of the 9,982 acres of soil disturbance under this alternative, and moderately restrictive wind erosion potential would affect 18% of the disturbed area. This alternative would affect more reclamation-limited soils than any other alternative. Because Alternative C would impact 4.9 times the area of soils as would be affected under the No Action Alternative (with a similar occurrence of restrictive features), it would also affect more reclamation-limited soils.

4.10.1.3.2 Biological Soil Crusts

This alternative would result in approximately 9,982 acres of surface disturbance, or 4.9 times the area of disturbance than would result under the No Action Alternative. Because the distribution of biological soils crusts in the area is unknown, an increase in surface disturbance is assumed to correspond to a similar increase in impacts to soil crusts. A total of 1,717 acres of pinyon-juniper woodland and 3,535 acres of sagebrush community types would be disturbed under the Proposed Action. This alternative would therefore have more risk of impacting biological soils crusts than the No Action Alternative, because it would impact approximately 5.4 times more area dominated by sagebrush communities and 6.2 times more area dominated by pinyon-juniper woodland communities, both of which are associated with soil crusts (see Table 4-94).

4.10.1.3.3 EROSION AND SEDIMENT YIELD

Removal of 9,982 acres of vegetation (4.9 times more than under the No Action Alternative) would increase the potential for channelized runoff and accelerated erosion to occur, with a corresponding increase in rill and gully erosion where disturbance occurs on steeper slopes. Construction on slopes greater than 30% is expected to take place on approximately 1,125 acres, or approximately 11% of the total acres disturbed during construction. Construction on slopes greater than 40% is expected to take place on approximately 605 acres, or approximately 6% of the total acres disturbed during construction (see Table 4-95). This is approximately 7.6 times as large an area of construction on 30% slopes, and 9.7 times as large an area on 40% slopes, as would occur under the No Action Alternative.

Increased soil erosion would generate an estimated 682,905 tons of sediment over the life of the project under this alternative, of which an estimated 136,581 tons would be delivered to active drainages that are tributary to the Green River (see Table 4-96). This is approximately 5.1 times more excess sediment than would be produced under the No Action Alternative. The assumptions used to calculate soil losses are the same as described under the Proposed Action.

4.10.1.4 ALTERNATIVE D: NO ACTION

Under the No Action Alternative, impacts to soil resources would be of the same nature as those described for the Proposed Action. However, they would be of far lesser magnitude and would affect far fewer acres. This alternative would impact approximately 2,055 acres of soil resources through the development of 368 wells.

4.10.1.4.1 REHABILITATION POTENTIAL

A smaller area of rehabilitation-restricted soils would be impacted under the No Action Alternative than under any other alternative, as shown in Table 4-93. As under the Proposed Action, site rehabilitation following this alternative's actions would be most limited by soils with excess sodium, alkalinity, droughty conditions, and poor reclamation potential. Each of these conditions occurs at the “highly restrictive” or “moderately restrictive” level over 56%–86% of the area that would be disturbed under the No Action Alternative (see Table 4-93). Highly to moderately restrictive rooting depths would affect 41% of the 2,055 acres of soil disturbance under this alternative, and moderately restrictive wind erosion potential would affect 27% of the disturbed area. This alternative would affect the smallest amount of reclamation-limited soils of any alternative.

4.10.1.4.2 BIOLOGICAL SOIL CRUSTS

The No Action Alternative would result in approximately 2,055 acres of vegetation disturbance or removal. Because the area's distribution of biological soils crusts is unknown, a decrease in surface disturbance is assumed to correspond to a similar decrease in impacts to soil crusts. A total of 278 acres of pinyon-juniper woodland and 652 acres of sagebrush community types would be disturbed under the No Action Alternative. This alternative would therefore have the least risk of impacting biological soils crusts of any alternative, because the smallest areas of vegetation communities associated with soil crusts would be disturbed (see Table 4-94).

4.10.1.4.3 *Erosion and Sediment Yield*

Construction on slopes greater than 30% is expected to take place on approximately 148 acres, or approximately 7% of the total acres disturbed during construction. Construction on slopes greater than 40% is expected to take place on approximately 62 acres, or approximately 3% of the total acres disturbed during construction (see Table 4-95).

Increases in soil erosion would generate an estimated 133,179 tons of sediment over the life of the project under this alternative, of which an estimated 26,636 tons would be delivered to active drainages that are tributary to the Green River (see Table 4-96). The assumptions used to calculate soil losses are the same as those described under the Proposed Action.

4.10.1.5 Alternative E: Reduced Development with Directional Drilling

Under this alternative, impacts to soil resources would be of the same nature as described for the Proposed Action. However, they would be of lesser magnitude and affect fewer acres. Well-pad locations would be precluded from some sensitive areas, and the number of well pads developed would be reduced to 328. This alternative would impact approximately 2,174 acres of soil resources, or approximately 1.1 times as large an area of soils as under the No Action Alternative.

4.10.1.5.1 *Rehabilitation Potential*

A smaller area of rehabilitation-restricted soils would be impacted under this alternative than the Proposed Action, as shown in Table 4-93. As with the Proposed Action, site rehabilitation following this alternative's actions would be most limited by soils with excess sodium, alkalinity, droughty conditions, and poor reclamation potential. Each of these conditions occurs at the "highly restrictive" or "moderately restrictive" level over 20% to 52% of the area that would be disturbed under Alternative E (see Table 4-93). Highly to moderately restrictive rooting depths would affect 31% of the 2,174 acres of soil disturbance under this alternative, and moderately restrictive wind erosion potential would affect 19% of the disturbed area. Because Alternative E would impact 1.1 times the area of soils as would be affected under the No Action Alternative (with a similar occurrence of restrictive features), it would also affect slightly more reclamation-limited soils.

4.10.1.5.2 *Biological Soil Crusts*

This alternative would result in approximately 2,174 acres of surface disturbance, or 1.1 times the area of disturbance that would result under the No Action Alternative. Because the distribution of biological soils crusts in the area is unknown, an increase in surface disturbance is assumed to correspond to a similar increase in impacts to soil crusts. A total of 126 acres of pinyon-juniper woodland and 776 acres of sagebrush community types would be disturbed under this alternative. This alternative would therefore have a similar risk of impacting biological soils crusts than the No Action Alternative, because it would impact approximately 124 more acres (or 1.2 times the area) dominated by sagebrush communities, and 152 fewer acres (or 0.5 times the area) dominated by pinyon-juniper woodland communities, both of which are associated with soil crusts (see Table 4-94).

4.10.1.5.3 EROSION AND SEDIMENT YIELD

Removal of 2,174 acres of vegetation (1.1 times the removal under the No Action Alternative) would slightly increase the potential for channelized runoff and accelerated erosion to occur, with a corresponding increase in rill and gully erosion where disturbance occurs on steeper slopes. Construction on slopes greater than 30% is expected to take place on approximately 209 acres, or approximately 10% of the total acres disturbed during construction. Construction on slopes greater than 40% is expected to take place on approximately 93 acres, or approximately 4% of the total acres disturbed during construction (see Table 4-95). This is approximately 1.4 times the area of construction on 30% slopes, and 1.5 times the area on 40% slopes, as would occur under the No Action Alternative.

Sediment yield from well pads and roads under Alternative E was calculated using the same assumptions as under the Proposed Action, with the following exception: Disturbance per developed well pad was assumed to be 4.2 acres for the well pad and 1.2 acres for each access road to the well pad. Total new disturbance per well pad would therefore be 5.4 acres.

Based on these assumptions, each well-pad development would contribute an additional 23.8 tons/year of soil loss the first year following disturbance (4.4 tons/acre × 5.4 acres). Each well development would create an additional 11.9 tons/year for the remaining 29 years of the expected 30-year development life (5.4 acres × 2.2 tons/acre).

At the end of 30 years, the well pad and access road would be reclaimed, and an additional 11.9 tons/year of sediment would continue to be produced for four years after reclamation, until the disturbed sites are stabilized (5.4 acres × 2.2 tons/acre).

Using the assumptions above, the total sediment produced above background rates per well pad is calculated below:

Year 1	23.8 tons
Years 2 through 29	11.9 tons/year @ 29 years = 344.5 tons
Years 21 through 34	11.9 tons/year @ 4 years = 47.5 tons

Total produced sediment for each well development for a span of 34 years would be 416 tons. If evenly distributed over each disturbed surface, this equates to the erosion of approximately 0.45 inches of soil. With 328 well pads proposed for development, approximately 136,382 tons of sediment would be produced over the life of the project (Table 4-96). This is approximately 1.02 times more excess sediment than would be produced under the No Action Alternative.

4.10.1.6 ALTERNATIVE F: AGENCY PREFERRED ALTERNATIVE

Under Alternative F, impacts to soil resources would be of the same nature as those described for the Proposed Action. However, they would be of lesser magnitude and would affect fewer acres. Well-pad locations would be precluded from some sensitive areas, and the number of well pads developed would be reduced to 575. This alternative would impact approximately 3,602 acres of soil resources through the development of 1,298 wells.

4.10.1.6.1 Rehabilitation Potential

A smaller area of rehabilitation-restricted soils would be impacted under this alternative than the Proposed Action, as shown in Table 4-93. As with the Proposed Action, site rehabilitation following this alternative's actions would be most limited by soils with excess sodium, alkalinity, droughty conditions, and poor reclamation potential. Each of these conditions occurs at the "highly restrictive" or "moderately restrictive" level over 40% to 67% of the area that would be disturbed under Alternative F (see Table 4-93). Highly to moderately restrictive rooting depths would affect 25% of the 3,602 acres of soil disturbance under this alternative, and moderately restrictive wind erosion potential would affect 12% of the disturbed area. Because Alternative F would impact 1.8 times the area of soils as would be affected under the No Action Alternative (with a similar occurrence of restrictive features), it would also affect more reclamation-limited soils.

4.10.1.6.2 Biological Soil Crusts

This alternative would result in approximately 3,602 acres of surface disturbance, or 1.8 times the area of disturbance that would result under the No Action Alternative. Because the distribution of biological soil crusts in the area is unknown, an increase in surface disturbance is assumed to correspond to a similar increase in impacts to soil crusts. A total of 706 acres of pinyon-juniper woodland and 1,508 acres of sagebrush community types would be disturbed under this alternative. This alternative would therefore have an increased risk of impacting biological soil crusts compared to the No Action Alternative, because it would impact approximately 856 more acres (or 2.3 times the area) dominated by sagebrush communities, and 428 more acres (or 2.5 times the area) dominated by pinyon-juniper woodland communities, both of which are associated with soil crusts (see Table 4-94).

4.10.1.6.3 Erosion and Sediment Yield

Removal of 3,602 acres of vegetation (1.8 times the removal under the No Action Alternative) would increase the potential for channelized runoff and accelerated erosion to occur, with a corresponding increase in rill and gully erosion where disturbance occurs on steeper slopes. Construction on slopes greater than 30% is expected to take place on approximately 215 acres, or approximately 6% of the total acres disturbed during construction. Construction on slopes greater than 40% is expected to take place on approximately 221 acres, or approximately 6.1% of the total acres disturbed during construction (see Table 4-95). This is approximately 1.5 times the area of construction on 30% slopes, and 3.6 times the area on 40% slopes, as would occur under the No Action Alternative.

With 575 well pads proposed for the development, increased soil erosion would generate an estimated 239,085 tons of sediment over the life of the project under this alternative, of which an estimated 47,817 tons would be delivered to active drainages that are tributary to the Green River (see Table 4-96). This is approximately 1.8 times more excess sediment than would be produced under the No Action Alternative. The assumptions used to calculate soil losses are the same as described under Alternative E.

4.10.2 MITIGATION

In addition to the applicant-committed measures detailed in Section 2.2.9, there are several proposed measures that could be used to reduce expected increases in sediment yields, and to lessen or negate impacts caused to soil, watershed, and floodplain resources. These are as follows:

- Road construction and other disturbance on slopes between 40% and 60% would be avoided. If it is not feasible to avoid these slopes, then the applicant would provide the AO with an erosion control plan, a road maintenance plan, and an engineered drawing of the proposed road. Approval from the AO would be required for all proposed roads traversing slopes between 40% and 60%.
- Well pads would be avoided within active drainages.
- To the fullest extent possible, access roads proposed in valley/drainage bottoms would be sited on the toe of the adjacent slope to the valley bottom. Roads would have appropriate energy dissipaters (e.g., water bars and silt fences) where water leaves the road and is routed toward an adjacent drainage.
- Well pads adjacent to drainages would be bermed to prevent runoff from entering the drainage.
- As conditions dictate, and as determined by the AO, diversion ditches would be constructed around the pad.
- Where diversion ditches are constructed to reroute drainages around well pads, ditches would be designed to return the diverted water back to the original channel. If it is not feasible to return diverted water back to its original channel, the water would be diverted to the nearest channel, with energy-dissipating devices installed to prevent channel degradation.
- The presence of biological soil crusts would be assessed on a site-specific basis during well-pad and road development and siting. Areas with crusts would be avoided as feasible, and any unavoidable disturbance would be mitigated as necessary.
- Additional measures to ensure successful reclamation would be implemented as determined by the AO, and could consist of (but would not be limited to) hydro mulching, supplemental mycorrhizal applications, erosion blankets, spray-on fiber matrices, tackifiers, etc.
- Erosion and sedimentation would be reduced through the use of BMPs including, but not limited to, berms, sediment control structures, grading, mulching, revegetation, and interim reclamation.
- Except in native badland soils that are unvegetated, all disturbed areas of access roads, other than the driving surface, would be revegetated as directed by the AO when the associated well is put into production. This includes, but is not limited to, the shoulders, drainage ditches, and cut and fill slopes of the access road.
- All applicable Fluid Minerals BMPs from Appendix R of the Vernal RMP (BLM 2008c) would be implemented.

- If surface-disturbing activities cannot be avoided on slopes from 21% to 40%, a plan would be required. The plan would be approved by BLM prior to construction and maintenance and include: (i) an erosion control strategy, (ii) GIS modeling, and (iii) proper survey and design by a certified engineer.

4.10.3 UNAVOIDABLE ADVERSE IMPACTS

Unavoidable adverse impacts from the Proposed Action include short- and long-term soil exposure and compaction; loss of soil productivity and topsoil due to erosion and disturbance of biological soil crusts; increased susceptibility of soil to both wind and water erosion because of a loss of stabilizing vegetative cover; and increased sediment yield due to proposed oil and gas facilities and infrastructure.

Under the Proposed Action, an estimated 107,979 tons of sediment (above natural background erosion) are expected to be eventually delivered to the Green River over the life of the project in spite of mitigation measures. Alternative B, Alternative C, the No Action Alternative, Alternative E and Alternative F would deliver 106,359 tons, 136,581 tons, 26,636 tons, 27,276 and 47,817 tons of sediment, respectively. These sediment inputs would be spread over the life of the project, and would therefore only slightly increase the approximately 2.2 million tons per year (tpy) sediment load of the Green River near the project area (BLM 2007a).

4.10.4 IRRETRIEVABLE AND IRREVERSIBLE COMMITMENTS OF RESOURCES

The activities proposed would result in short- and long-term changes to soil productivity due to surface disturbance and loss of vegetation. This loss of soil productivity would be irretrievable until restoration is complete. In some areas, soils restrict rehabilitation success. It is possible that soil in these areas would experience some irreversible impacts due to the difficulty in restoring vegetation.

4.10.5 RELATIONSHIP OF SHORT-TERM USES TO LONG-TERM PRODUCTIVITY

Construction of oil and gas facilities and infrastructures would provide a short-term mineral use that would eventually result in long-term loss of soil productivity in localized areas impacted by development activities. Long-term impacts to soil productivity would be primarily the result of vegetation removal or prevention of revegetation, which would allow continued erosion of soil. Impacts would persist until surface disturbance and vegetation loss are reclaimed.

4.11 SPECIAL DESIGNATIONS

Special management areas are designated by the BLM for the protection and management of specific resources and values of concern. Their management priorities allow uses considered compatible with those resources and values, while limiting or restricting uses that may be detrimental. Special management areas include ACECs, Wild and Scenic Rivers (WSRs), and designated Wilderness Areas. No designated Wilderness Areas or WSAs exist within the project area, so this chapter deals exclusively with ACECs and suitable WSRs (see Map 24). Management of the existing ACECs in the project area is focused on resources and values that are relevant and important to each specific ACEC. The relevant and important values of potential ACECs and outstanding remarkable values and tentative classification of eligible WSR segments are described in the Vernal RMP (BLM 2008c).

Potential direct impacts to ACECs from the Proposed Action and alternatives include surface disturbance and intrusions that may affect the ACECs relevant and important values. ACECs would also be indirectly affected by activities that impact their relevant and important values. These impacts vary by ACEC but include disturbance of specifically protected riparian and wetland habitat, cultural resources, wildlife and waterfowl, scenic and recreational value, and special status species. Potential directs and indirect impacts to WSRs would be the same as ACECs except they would affect the outstandingly remarkable values of the river.

The analysis presented in this chapter focuses on impacts to the specific values that are relevant to the designation of each ACEC or potential ACEC and to the outstandingly remarkable values of the WSRs.

4.11.1 Direct and Indirect Effects

4.11.1.1 Alternative A: Proposed Action

4.11.1.1.1 Pariette Wetlands ACEC

The 10,437-acre Pariette Wetlands (4,859 acres of which is within the project area) is composed of a wetland ecosystem that contains special status bird and plant species, including the Uinta Basin hookless cactus (*Sclerocactus wetlandicus*) and Pariette cactus (*Sclerocactus brevispinus*); both plants are federally listed as threatened under the original *Sclerocactus glaucus* listing. The BLM's objective for managing the Pariette Wetlands is to protect special status bird and plant species and habitat, wetlands ecosystem, waterfowl production, and soil (BLM 2008c).

The BLM's management prescriptions for the Pariette Wetlands ACEC emphasize seasonal and surface occupancy restrictions for wildlife and plant species, protection of floodplains and erosive soils, and the management of vegetation to benefit riparian and watershed values. The development of oil and gas resources is restricted to protect the natural area. However, some of the leases may predate the Vernal RMP that imposed those restrictions. If that is the case, as provided in the Vernal RMP development of those leased resources cannot be precluded by the referenced restrictions (but must be in conformance with all applicable laws and regulations, such as the Endangered Species Act (ESA). However, any off-lease access routes, pipelines and other supporting facilities that are necessary to access the leases would be subject to the management guidance in the Vernal RMP currently in effect at the time of the site-specific application. Additional site-specific review may be necessary, and ROW actions would be permitted through the ROW process. During the site-specific review level, the applications associated with those leases would be reviewed for impacts to the relevant and important values of that ACEC. Applicant-committed measures and mitigation measures identified in this EIS, and other mitigation, if necessary, would be implemented to minimize or eliminate those impacts.

Development of well pads, roads, and associated features under Alternative A (Proposed Action) would disturb approximately 74 acres of the ACEC. This equals approximately 0.7% of the Pariette Wetlands ACEC's entire 10,437 acres, and approximately 1.5% of the 4,859 acres of the ACEC within the project area.

Effects specific to the relevant values for the Pariette Wetlands ACEC include surface disturbance to wetland and riparian habitat (as permitted by the U.S. Army Corps of Engineers [USACE]), disturbance to nesting waterfowl, sedimentation of water in Pariette Draw, and disturbance within potential habitats for the Uinta Basin hookless cactus (*Sclerocactus wetlandicus*) and Pariette cactus (*Sclerocactus brevispinus)*. As described in Chapter 3, the Uinta Basin hookless cactus' potential habitat areas consist of the benches above the Green River, previously delineated polygons at the base of the Badland Cliffs (BLM 2002c), and known occurrences documented from recent habitat and occurrence surveys within the project area (SWCA 2005, 2006, USFWS 2011 habitat polygon).

Project-related development would disturb approximately 11 acres of riparian habitat, including removal of riparian and wetland vegetation. This equals 0.6% of the total riparian habitat present in the ACEC and results in 11 more acres disturbed in riparian habitat than would occur under the No Action Alternative. Additional impacts to wetlands and riparian zones, such as invasion by noxious weeds, are more thoroughly analyzed in Section 4.13, Vegetation, and Section 4.15, Water Resources.

Disturbance of riparian habitat would also disturb nesting waterfowl. Under the Proposed Action, nesting waterfowl would be impacted by noise from drilling and production, by construction impacts from drilling, and from easier human access to nesting sites. Analysis of disturbance within 0.25 mile of waterfowl habitat in the ACEC shows the Proposed Action affecting approximately 47 acres of habitat. This is approximately 0.4% of total acreage within 0.25 mile of waterfowl nesting habitat in the ACEC, and 1% of the waterfowl nesting habitat within the ACEC and the project area. It would result in 46 more acres of disturbance than under the No Action Alternative.

Development under the Proposed Action would not disturb any highly erosive soils in the Pariette Wetlands ACEC. Therefore, a measurable increase in sedimentation to Pariette Draw is not anticipated.

The Proposed Action would disturb approximately 74 acres of potential habitat for the Uinta Basin hookless cactus. This is approximately 2.1% of the 3,553 acres of potential habitat in the project area and the ACEC. It would result in approximately 58 times the acres of potential habitat that would be disturbed under the No Action Alternative. Under the Proposed Action, there would be no impacts to the Pariette cactus core conservation areas developed in 2009 as a result of the Castle Peak/Eightmile Flat EIS consultation (referred to hereafter in this section as the 2009 core conservation area) and which contain nesting and foraging habitat for the species' insect pollinators. Impacts to special status species are described more thoroughly in Section 4.12, Special Status Species.

4.11.1.1.2 LOWER GREEN RIVER ACEC

The Lower Green River ACEC totals 8,470 acres (of which 3,090 acres fall within the project area). The Lower Green River ACEC was designated for its relevant and important values of scenery, special status plant and animal species, and riparian habitat. The management objectives that pertain to all ACECs according to the Vernal RMP (BLM 2008c) are to "protect and prevent irreparable damage important historic, cultural, or scenic values; fish and wildlife resources; or other natural system or processes, or to protect life and safety from natural hazards."

The ACEC management prescriptions for the area emphasize the protection of riparian and special status species through seasonal and surface occupancy restrictions and the protection of the Green River viewshed. Surface occupancy for leasable materials is restricted on 8,399 acres. However, some of the leases may predate the Vernal RMP that imposed those restrictions. If that is the case, as provided in the Vernal RMP development of those leased resources cannot be precluded by the referenced restrictions (but must be in conformance with all applicable laws and regulations, such as the ESA). However, any off-lease access routes, pipelines and other supporting facilities that are necessary to access the leases would be subject to the management guidance in the Vernal RMP currently in effect at the time of the site-specific application. Additional site-specific review may be necessary, and ROW actions would be permitted through the ROW process. During the site-specific review level, the applications associated with those leases would be reviewed for impacts to the relevant and important values of that ACEC. Applicant-committed measures and mitigation measures identified in this EIS, and other mitigation, if necessary, would be implemented to minimize or eliminate those impacts.

Development of well pads, roads, and associated features under the Proposed Action would disturb approximately 45 acres of the ACEC. This equals approximately 0.5% of the Lower Green River ACEC's entire 8,470 acres and approximately 1.4% of the 3,090 acres of the ACEC that overlap the project area.

Effects specific to the relevant values for the Lower Green River ACEC may include surface disturbance to riparian habitat, noise impacts to the special status animal species, disturbance within potential habitat for the Uinta Basin hookless cactus (*Sclerocactus wetlandicus*), impacts to special status fish, and the 0.5-mile buffer around raptor nests.

The river is an important riparian ecosystem that supports a diversity of wildlife species. Critical habitat for 2 federally listed endangered fish is located within this ACEC: the Colorado pikeminnow and the razorback sucker (BLM 2008b). Impacts to highly erodible soils would affect critical habitat for the 2 endangered fish species. Additional impacts to endangered fish are discussed in Section 4.12, Special Status Species.

Project-related development would not directly disturb any riparian habitat or highly erodible soils. Impacts to riparian areas could occur through indirect means, such as invasion by noxious weeds from impacted adjacent upland areas. These impacts are more thoroughly analyzed in Section 4.13, Vegetation. The Proposed Action would have the same impact on riparian habitat as would the No Action Alternative.

Under the Proposed Action, seven wells would be situated within 0.25 mile of the Green River. This is approximately 3.5 times as many wells as would be present under the No Action Alternative. The development of these wells would present a short-term negative impact from noise during drilling to special status animal species because construction equipment noise levels could be up to 88 dBA 50 feet from the source. It is likely that many special status animal species would avoid the area during construction and would travel greater distances to avoid the noise. Daily production noise impacts (from running wells and vehicle visits to well locations) within this same area are expected to be below 55 dBA, and would therefore not be likely to impact most species. Applicant-committed measures regarding raptors would mitigate impacts to any bald eagle roost sites in the ACEC, as described in Section 4.12, Special Status Species.

The Proposed Action would have 11 wells and 1 mile of roads within line of sight from the Lower Green River (including seven within 0.25 mile of the river as described above). This is approximately twice the number of wells within line of sight than would occur under the No Action Alternative. Most wells would have short-term negative visual impacts during drilling when the drilling rig is in place, but would likely not be seen during production because of mitigation and removal of the drilling rig, although some well locations may have infrastructure (well pads, tanks, etc.) visible during production. The visibility of the infrastructure would have the potential to adversely impact the scenic quality of the ACEC if it could not be mitigated. Applicant-committed BMPs for the site-specific use where appropriate of buried pipelines and centralized water and condensate tank facilities would reduce the visual impacts of pipelines and tanks.

The Proposed Action would disturb approximately 49 acres within potential habitat for the Uinta Basin hookless cactus (*Sclerocactus wetlandicus*). This is approximately 1.0% of the 5,167 acres of potential habitat in the ACEC that is within the project area. This alternative would disturb 28 acres more than the No Action Alternative. The Proposed Action would also disturb approximately 1 acre within the 0.5-mile buffer surrounding known raptor nests. Impacts to special status species are described more thoroughly in Section 4.12, Special Status Species.

4.11.1.1.3 Nine Mile Canyon ACEC

The Nine Mile Canyon ACEC covers 44,168 acres (34,653 acres of which occur within the project area) and contains nationally significant Fremont, Ute, and Archaic rock art and structures; regionally noteworthy populations of special status plant species; and high-quality visual scenery. The ACEC is located along the project area's southern border. The BLM's management objectives for the Nine Mile Canyon ACEC stipulate that the BLM must “protect the relevant and important cultural resource, scenic and special status species values” (BLM 2008c).

The ACEC management prescriptions for the area emphasize the preservation of cultural sites, and habitat for a variety of special status plant and animal species, such as antelope, bighorn sheep, elk, and mule deer range. The prescriptions preserve these values through seasonal and surface occupancy restrictions. Operations pertaining to oil and gas development in the area are restricted by stipulations designed to protect the natural and primitive values of the area. However, some of the leases may predate the Vernal RMP that imposed those restrictions. If that is the case, as provided in the Vernal RMP development of those leased resources cannot be precluded by the referenced restrictions. However, any off-lease access routes, pipelines and other supporting facilities that are necessary to access the leases would be subject to the management guidance in the RMP currently in effect at the time of the site-specific application. Additional site-specific review may be necessary, and ROW actions would be permitted through the ROW process. During the site-specific review level, the applications associated with those leases would be reviewed for impacts to the relevant and important values of that ACEC. Applicant-committed measures and mitigation measures identified in this EIS, and other mitigation, if necessary, would be implemented to minimize or eliminate those impacts.

Development of well pads, roads, and associated features under the Proposed Action would disturb approximately 844 acres of the ACEC. This equals approximately 1.9% of the Nine Mile Canyon ACEC's entire 44,168 acres, and approximately 2.4% of the 34,653 acres of the ACEC that overlap with the project area.

Effects specific to the BLM's management objectives for the Nine Mile Canyon ACEC include surface disturbance impacts to cultural resources, visual and noise impacts to the area's recreational values, disturbance within potential habitats for the Uinta Basin hookless cactus (*Sclerocactus wetlandicus*), occupied habitats for the shrubby reed-mustard (*Schoenocrambe suffrutescens*) and Graham's beardtongue (*Penstemon grahamii*), potential habitat for Untermann daisy (*Erigeron untermannii*), and disturbance of other wildlife habitat.

Project-related development would disturb approximately 89 acres considered high-probability for the presence of cultural resources in the Vernal RMP (BLM 2008b). This equals 0.9% of all high probability areas present in the part of the project area that overlaps the ACEC. The Proposed Action would result in approximately 5 times as many acres of impact in high probability areas as would the No Action Alternative. However, the applicant-committed measures and BMPs described in Section 2.2.9.1 and Table 2-1 would greatly reduce the risk of adverse impacts, as described in Section 4.3, Cultural Resources.

Under the Proposed Action, 170 wells would be situated within 0.25 mile of Nine Mile Canyon. The development of these wells would create a short-term negative noise impact to the recreational values of the Nine Mile Canyon ACEC during drilling because noise levels from construction equipment could be up to 88 dBA 50 feet from the source. A recreationist would have to travel 0.5 mile from the source to reduce the noise levels below 55 dBA, the level at which sounds are not likely to interfere with recreational activities. Daily productional noise impacts (from vehicle visits) within this same area are expected to be below 55 dBA, and would therefore not be likely to impact the area's recreational opportunities. The impacts of wells on recreation are discussed in more detail in Section 4.8, Recreation.

The Proposed Action would have no wells or roads within line of sight from Nine Mile Creek. This is no different than under the No Action Alternative. Visual impacts are discussed more thoroughly in Section 4.14, Visual Resources.

Development under the Proposed Action would disturb approximately 791 acres of potential habitat for the Uinta Basin hookless cactus (*Sclerocactus wetlandicus*). This is approximately 2.4% of the 32,579 acres of potential habitat in the ACEC that is within the project area. This is 8 times more disturbance than would occur under the No Action Alternative. Development would also disturb approximately 27 acres, or 1.9% of the Badlands Cliff shrubby reed-mustard habitat area, all 1,449 acres of which are entirely within the Nine Mile Canyon ACEC. There is also approximately 0.3 acre, or less than 1% of 73 acres of occupied Graham's beardtongue habitat in the Nine Mile Canyon ACEC, and approximately 151 acres, or 2.2%, of 6,859 acres of potential Untermann daisy habitat in the Nine Mile Canyon ACEC (Table 4-97).

As can be seen in Table 4-97, disturbance to shrubby reed-mustard, Graham's beardtongue and Untermann daisy habitat is approximately 27, 0.3, and 124 more acres of disturbance respectively, than would occur under the No Action Alternative. Impacts to special status plant species are described more thoroughly in Section 4.12, Special Status Species.

Table 4-97. Acres of Special Status Species Habitat (and Percentage in ACEC) Directly Disturbed within the Nine Mile Canyon ACEC

Species	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Uinta Basin Hookless Cactus	791 (2.4%)	281 (0.9%)	1,115 (0.3%)	103 (0.3%)	116 (0.4%)	499 (1.5%)
Shrubby Reed-mustard	27 (1.9%)	19 (1.3%)	26 (1.8%)	<1 (<0.01%)	9 (0.6%)	32 (2.2%)
Graham's Beardtongue	0.3 (0.4%)	0.3 (0.4%)	0.3 (0.4%)	0 (0%)	0 (0%)	0 (0.0%)
Untermann Daisy	151 (2.2%)	109 (1.6%)	219 (3.2%)	27 (0.4%)	25 (0.4%)	170 (2.5%)

Note: Acreages shown are within ACEC boundaries and habitat designations established in the Vernal RMP (BLM 2008c).

Project-related development would directly disturb areas designated as antelope, bighorn sheep, elk, and mule deer range in the Vernal RMP (BLM 2008c). The acreages of these species' habitats that would be disturbed within the Nine Mile Canyon ACEC under the Proposed Action are shown in Table 4-98 below. Table 4-98 also shows a comparison of the percentage of difference between the Proposed Action and the No Action Alternative. Additional indirect impacts to wildlife, such as habitat fragmentation, are detailed in Section 4.16, Wildlife.

Table 4-98. Acres of Wildlife Habitat Directly Disturbed within the Nine Mile Canyon ACEC

Habitat Season	Habitat Designation[1]	Alternative A (Proposed Action)		Alternative B (Reduced)		Alternative C (Full)		Alternative D (No Action)	Alternative E (Directional)		Alternative F (Agency Preferred)	
		Acres	% Dif.[2]	Acres	% Dif.[2]	Acres	% Dif.[2]	Acres	Acres	% Dif.[2]	Acres	% Dif.[2]
Antelope												
Year-long	Crucial	22	550%	22	550%	75	1875%	4	13	325%	9	225%
	High priority	592	1057%	157	280%	521	930%	56	58	103%	356	636%
	Substantial	0	0%	0	0%	0	0%	0	0	0%	0	0%
	Limited	225	500%	127	282%	556	1236%	45	49	109%	151	336%
Bighorn Sheep												
Year-long potential		829	829%	294	294%	1,163	1163%	100	115	115%	500	500%
Elk												
Winter	Crucial	17	340%	17	340%	23	460%	5	6	120%	19	380%
	High priority	633	1130%	153	273%	607	1084%	56	55	98%	359	641%
	Substantial	22	450%	22	450%	75	1775%	4	13	325%	9	225%
	Limited	172	441%	118	203%	478	1126%	39	46	118%	129	331%

Table 4-98. Acres of Wildlife Habitat Directly Disturbed within the Nine Mile Canyon ACEC

Habitat Season	Habitat Designation[1]	Alternative A (Proposed Action)		Alternative B (Reduced)		Alternative C (Full)		Alternative D (No Action)	Alternative E (Directional)		Alternative F (Agency Preferred)	
		Acres	% Dif.[2]	Acres	% Dif.[2]	Acres	% Dif.[2]	Acres	Acres	% Dif.[2]	Acres	% Dif.[2]
Deer												
Year-long	Crucial	0	0%	3	300%	28	2800%	0	2	200%	0	0%
	High priority	0	0%	0	0%	0	0%	0	0	0%	0	0%
	Substantial	0	0%	0	0%	0	0%	0	0	0%	0	0%
	Limited	396	707%	127	227%	784	1400%	56	54	96%	238	425%
Winter	Crucial	0	0%	0	0%	2	200%	0	0	0%	0	0%
	High priority	438	995%	171	389%	366	832%	44	64	145%	271	616%
	Substantial	7	175%	9	225%	4	100%	4	0	0%	7	175%
	Limited	0	0%	0	0%	0	0%	0	0	0%	0	0%

[1] Acreages shown are within ACEC boundaries and habitat designations established in the Vernal RMP (BLM 2008c).
[2] Compared to the No Action Alternative.

4.11.1.1.4 Lower Green River Suitable Wild and Scenic River

The lower segment of the Green River within the project area was found suitable for congressional designation in the Vernal RMP (BLM 2008c), and it is currently managed to protect its free-flowing nature, outstandingly remarkable values, and tentative classifications. The Vernal RMP tentatively classifies the Lower Green River as a potential Scenic river. The BLM currently manages approximately 27 miles of shoreline out of 30 shoreline miles along the river. The outstanding remarkable values identified in the Vernal RMP are recreation and fish.

Development of well pads, roads, and associated features under the Proposed Action would disturb approximately 61 acres of the proposed Lower Green River suitable WSR. This equals approximately 0.5% of the proposed Lower Green River suitable WSR's entire 11,967 acres. The number of wells and acres of disturbed lands within the proposed Lower Green River suitable WSR under the Proposed Action is shown in Table 4-99 below.

Table 4-99. Total Acres of Disturbance, Number of Wells with 0.25 Mile, and Number of Wells within Line-of-sight of the Lower Green River Suitable WSR

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Wells within 0.25 mile	7	8	3	2	3	0
Wells within line of sight	8	6	2	2	2	0
Miles of road within line of sight	0.8	1.1	0.9	0.3	0.2	0.6
Total acres impacted	61	56	36	25	14	0

Effects specific to the Lower Green River suitable WSR include visual and noise impacts on the proposed WSR's scenic and recreational values and impacts to special status fish species. The river is an important riparian ecosystem that supports a diversity of wildlife species. Critical habitat for 2 federally listed endangered fish is located within this potential WSR: the Colorado pikeminnow, and the razorback sucker (BLM 2008b). Impacts to highly erodible soils could affect critical habitat for the 2 endangered fish species. However, project-related development would not directly disturb any highly erodible soils. Additional impacts to endangered fish are discussed in Section 4.12, Special Status Species.

Project-related development would not directly disturb any riparian habitat. Impacts to riparian areas could occur through indirect means, such as invasion by noxious weeds from impacted adjacent upland areas. These impacts are more thoroughly analyzed in Section 4.13, Vegetation.

Under the Proposed Action, seven wells would be situated within 0.25 mile of the proposed Lower Green River suitable WSR. This is approximately 3.5 times as many wells as would be present in the same area under the No Action Alternative. The development of these wells would create a short-term negative impact from noise to the wild and scenic quality of the Lower Green River suitable WSR during drilling because construction equipment noise levels (estimated to be 88 dBA 50 feet from source) would still be above 55dBa (the level at which sounds are not likely to interfere with recreational activities) at river level (see Table 4-82.). A recreationist would have to travel 0.5 mile from the source to reduce the noise levels below 55 dBA, the level at which sounds are not likely to interfere with recreational activities. Daily productional noise impacts (from running wells and vehicle visits to well locations) within this same area are expected to be below 55 dBA, and would therefore not be likely to impact the wild and scenic characteristics of the area. The impacts of wells on recreation are discussed in more detail in Section 4.8, Recreation.

The Proposed Action would have eight wells and 0.8 mile of roads within line of sight from the Lower Green River. This is approximately 4 times as many wells as would be within line of sight under the No Action Alternative. Most wells would have short-term negative impacts during drilling when the drilling rig is in place, but they would likely not be seen during production because of mitigation. However, some well locations may have infrastructure (well pads, tanks, etc.) visible during production. The visibility of the infrastructure would have the potential to adversely impact the scenic quality of the WSR if it could not be mitigated. Because the suitable WSR is subject to valid existing rights these impacts may be allowed. However, the BLM would work with and be subject to the agreement of holders of valid existing rights to modify proposed actions or activities to reduce the effect of the actions or activities on resource values and uses.

In addition, applicant-committed BMPs for the site-specific use where appropriate of buried pipelines and centralized water and condensate tank facilities would reduce the visual impacts of pipelines and tanks. Visual impacts are discussed more thoroughly in Section 4.14, Visual Resources.

4.11.1.2 Alternative B: Reduced Development

4.11.1.2.1 Pariette Wetlands ACEC

Development of well pads, roads, and associated features under Alternative B would disturb 2 acres of the Pariette Wetlands ACEC. This is approximately 0.04% of the ACEC's 4,859 acres within the project area.

Development under this alternative would not disturb any highly erosive soils in the Pariette Wetlands ACEC. Therefore, it would cause a negligible increase in sedimentation to Pariette Draw.

There would be no disturbance to riparian zones and wetlands under Alternative B; therefore, impacts would be identical to those under the No Action Alternative. Analysis of disturbance within 0.25 mile of waterfowl habitat in the ACEC shows Alternative B impacting approximately 1 acre. This is less than 0.1% of acreage within 0.25 mile of waterfowl habitat in the ACEC within the project area. Impacts under this alternative would be identical to those under the No Action Alternative.

Alternative B would impact 1.9 acres of Uinta Basin hookless cactus (*Sclerocactus wetlandicus*) potential habitat. This equates to less than 0.1% of the 3,552 acres of potential habitat that is within the ACEC and the project area. There would be no direct impacts to the 2009 Pariette cactus core conservation areas. Impacts to special status species are described more thoroughly in Section 4.12, Special Status Species.

4.11.1.2.2 Lower Green River ACEC

Development of well pads, roads, and associated features under Alternative B would disturb approximately 38 acres of the Lower Green River ACEC. This equals approximately 0.4% of the ACEC's entire 8,470 acres and 1.2% of the ACEC's 3,090 acres within the project area.

Project-related development would not directly disturb any riparian habitat or highly erodible soils. Impacts to riparian areas could occur through indirect means, such as invasion by noxious weeds from impacted adjacent upland areas. These weed impacts are more thoroughly analyzed in Section 4.13, Vegetation. Alternative B would have the same impact on riparian habitat as would the No Action Alternative.

Under Alternative B, 8 wells would be situated within 0.25 mile of the Green River. This is approximately 4 times as many wells as would be present under the No Action Alternative. These wells would create a short-term negative impact from noise to the wild and scenic quality of the Lower Green River ACEC during drilling. Daily productional noise impacts (from running wells and vehicle visits to well locations) within this same area are expected to be below 55 dBA, and would therefore not be likely to impact the area's wild and scenic quality. Applicant-committed measures regarding raptors would mitigate impacts to any bald eagle roost sites in the ACEC, as described in Section 4.12, Special Status Species.

Alternative B would have 9 wells and 2 miles of roads within line of sight from the Lower Green River. This is approximately twice as many wells as under the No Action Alternative. Most wells would have short-term negative impacts during drilling when the drilling rig is in place, but they would likely not be seen during production because of mitigation. However, some well locations may have infrastructure (well pads, tanks, etc.) visible during production. Applicant-committed BMPs for the site-specific use of buried pipelines and centralized water and condensate tank facilities would reduce the visual impacts of pipelines and tanks where appropriate.

Alternative B would disturb approximately 40 acres within potential habitat for the Uinta Basin hookless cactus (*Sclerocactus wetlandicus*). This is approximately 0.8% of the 5,167 acres of potential habitat in the project area and the ACEC. This is approximately 70% more acres of disturbance as under the No Action Alternative. Alternative B would not disturb any areas within the 0.5-mile buffer surrounding known raptor nests. Impacts to special status species are described more thoroughly in Section 4.12, Special Status Species.

4.11.1.2.3 Nine Mile Canyon ACEC

Development of well pads, roads, and associated features under Alternative B would disturb approximately 310 acres of the Nine Mile Canyon ACEC. This equals approximately 0.6% of the ACEC's 44,168 acres and 0.4% of the ACEC's 34,653 acres within the project area.

Project-related development would disturb approximately 51 acres considered high-probability for the presence of cultural resources, or 0.5 % of the 9,529 acres of all high-probability areas that are present within that part of the ACEC that overlaps the project area. This is approximately 3 times as many acres of high probability areas as under the No Action Alternative. However, the applicant-committed measures and BMPs described in Section 2.2.9.1 and Table 2-1 would greatly reduce the risk of adverse impacts, as described in Section 4.3, Cultural Resources.

Under Alternative B, 47 wells would be situated within 0.25 mile of Nine Mile Canyon. These wells would create a short-term negative noise impact to the scenic and recreational values of the Nine Mile Canyon ACEC during drilling because noise levels from construction equipment could be up to 88 dBA 50 feet from the source. A recreationist would have to travel 0.5 mile from the source to reduce the noise levels below 55 dBA, the level at which sounds are not likely to interfere with recreational activities. Visual impacts would temporarily result from the drilling rigs. Daily productional noise impacts (from vehicle visits) within this same area are expected to be below 55 dBA, and would therefore not be likely to impact the area's recreational opportunities. The impacts of wells on recreation are discussed in more detail in Section 4.8, Recreation.

Alternative B would have 2 wells and 1 mile of roads within line of sight from Nine Mile Creek. This is approximately twice as many wells within line of sight as under the No Action Alternative. Most wells would have short-term negative impacts during drilling when the drilling rig is in place, but through mitigation, they would likely not be seen during production. However, some well locations may have infrastructure (well pads, tanks, etc.) visible during production. The visibility of the infrastructure would have the potential to adversely impact the scenic quality of the ACEC if it could not be mitigated. Applicant-committed BMPs for the site-specific use where appropriate of buried pipelines and centralized water and condensate tank facilities would reduce the visual impacts of pipelines and tanks. Visual impacts are discussed more thoroughly in Section 4.14, Visual Resources.

Alternative B would disturb approximately 281 acres within potential habitat for the Uinta Basin hookless cactus (*Sclerocactus wetlandicus*) within the ACEC. This is approximately 0.9% of the 32,578 acres of potential habitat in the project area and the ACEC. This is 2.7 times as many acres of disturbance as under the No Action Alternative. It would also disturb approximately 19 acres of the Badlands Cliff shrubby reed-mustard habitat area (approximately 1.3% of 1,449 acres within the Nine Mile Canyon ACEC), 0.3 acres of Graham's beardtongue habitat (out of 73 acres within the Nine Mile Canyon ACEC), and 109 acres of Untermann daisy habitat (out of 6,859 acres within the Nine Mile Canyon ACEC). As can be seen in Table 4-97, disturbance to shrubby reed-mustard, Graham's beardtongue, and Untermann daisy habitat is approximately 19, 0.3, and 82 more acres of disturbance, respectively, than would occur under the No Action Alternative. Impacts to special status species are described more thoroughly in Section 4.12, Special Status Species.

Project-related development would directly disturb areas designated as antelope, bighorn sheep, elk, and mule deer range in the Diamond Mountain RMP (BLM 1994). The acres of these species' habitats that would be disturbed within the Nine Mile Canyon ACEC under Alternative B are shown in Table 4-98 in comparison to all other alternatives. Overall, Alternative B would have greater impact to wildlife habitat than would the No Action Alternative but less than would the Proposed Action. Additional indirect impacts to wildlife, such as habitat fragmentation, are detailed in Section 4.16, Wildlife.

4.11.1.2.4 Lower Green River Suitable Wild and Scenic River

Development of well pads, roads, and associated features under Alternative B would disturb approximately 56 acres of the proposed Lower Green River suitable WSR. This equals approximately 0.5% of the Lower Green River suitable WSR's entire 11,967 acres. Project-related development would not directly disturb any riparian habitat or highly erodible soils. Impacts to riparian areas could occur through indirect means, such as invasion by noxious weeds from impacted adjacent upland areas. These impacts are more thoroughly analyzed in Section 4.13, Vegetation.

Under Alternative B, 8 wells would be situated within 0.25 mile of the Lower Green River suitable WSR. This is approximately 4 times as many wells as would be present in the same area under the No Action Alternative (see Table 4-99). These wells would create a short-term negative impact from noise to the wild and scenic quality of the Lower Green River suitable WSR during drilling. Daily productional noise impacts (from running wells and vehicle visits to well locations) within this same area are expected to be below 55 dBA, and would therefore not be likely to impact the area's wild and scenic qualities.

Alternative B would have six wells and 1.1 miles of roads within line of sight from the Lower Green River (see Table 4-99). This is approximately 3 times as many wells within line of sight as under the No Action Alternative. Most wells would have short-term negative impacts during drilling when the drilling rig is in place, but they would likely not be seen during production because of mitigation. However, some well locations may have infrastructure (well pads, tanks, etc.) visible during production. The visibility of the infrastructure would have the potential to adversely impact the scenic quality of the WSR if it could not be mitigated. Because the suitable WSR is subject to valid existing rights these impacts may be allowed. However, the BLM would work with and subject to the agreement of holders of valid existing rights to modify proposed actions or activities to reduce the effect of the actions or activities on resource values and uses.

In addition, applicant-committed BMPs for the site-specific use where appropriate of buried pipelines and centralized water and condensate tank facilities would reduce the visual impacts of pipelines and tanks. Visual impacts are discussed more thoroughly in Section 4.14, Visual Resources.

4.11.1.3 ALTERNATIVE C: FULL DEVELOPMENT

4.11.1.3.1 PARIETTE WETLANDS ACEC

Development of well pads, roads, and associated features under Alternative C would disturb approximately 26 acres of the Pariette Wetlands ACEC. This equals approximately 0.2% of the ACEC and 0.5% of the 4,859 acres of the ACEC within the project area.

There would be approximately 4 acres of disturbance in riparian zones and wetlands under Alternative C, which is 4 acres more than would be impacted under the No Action Alternative. Analysis of disturbance within 0.25 mile of waterfowl habitat in the ACEC shows Alternative C impacting approximately 18 acres. This is approximately 0.4% of total waterfowl nesting habitat in the ACEC that is within the project area, and is 17 acres more disturbance than would occur under the No Action Alternative. Impacts related to the disturbance of wildlife habitat are discussed in more detail in Section 4.16, Wildlife.

Under Alternative C, the proposed project would impact 25 acres of potential habitat for the Uinta Basin hookless cactus (*Sclerocactus wetlandicus*) and 3 acres of potential habitat for the Pariette cactus (*Sclerocactus brevispinus*). This is approximately 0.7% of the 3,552 acres of potential habitat for Uinta Basin hookless cactus and 0.3% of the 1,313 acres of potential habitat for Pariette cactus in the project area and the ACEC. This is 19 times more acres of Uinta Basin hookless cactus habitat disturbed and 2.6 times more acres of Pariette cactus habitat disturbed than would occur under the No Action Alternative. Under Alternative C, there would be no direct impacts to the 2009 Pariette cactus core conservation areas. Impacts to special status species are described more thoroughly in Section 4.12, Special Status Species.

4.11.1.3.2 LOWER GREEN RIVER ACEC

Development of well pads, roads, and associated features under Alternative C would disturb approximately 23 acres of the Lower Green River ACEC. This equals approximately 0.3% of the entire ACEC (8,470 acres) and 0.7% of the 3,090 acres within the area of the ACEC within the project area.

Project-related development would disturb 0.1 acres of riparian habitat and no highly erodible soils. Impacts to riparian areas could occur through indirect means, such as invasion by noxious weeds from impacted adjacent upland areas. These impacts from weeds are more thoroughly analyzed in Section 4.13, Vegetation. Alternative C would have slightly more impact on riparian habitat than would the No Action Alternative.

Under Alternative C, three wells would be situated within 0.25 mile of the Green River, and would therefore be likely to result in noise impacts at river level above 55 dBA during drilling. This is 1 well more than would be present under the No Action Alternative. These wells would create a short-term negative impact from noise to the wild and scenic quality of the Lower Green River ACEC during drilling because construction equipment (estimated to be 88 dBA 50 feet from source) would still be above 55 dBA (the level at which sounds are not likely to interfere with recreational activities) at river level (see Table 4-82.). A recreationist would have to travel 0.5 mile from the source to reduce the noise levels below 55 dBA, the level at which sounds are not likely to interfere with recreational activities. Daily productional noise impacts (from running wells and vehicle visits to well locations) within this same area are expected to be below 55 dBA, and would therefore not be likely to impact the recreational opportunities. The impacts of wells on recreation are discussed in more detail in Section 4.8, Recreation. Applicant-committed measures regarding raptors would mitigate impacts to any bald eagle roost sites in the ACEC, as described in Section 4.12, Special Status Species.

Alternative C would have five wells and 1 mile of roads within line of sight from the Lower Green River. This is the same number of wells within line of sight as under the No Action Alternative. Most wells would have short-term negative impacts during drilling when the drilling rig is in place, but they would likely not be seen during production because of mitigation and the removal of the drilling rig. However, some well locations may have infrastructure (well pads, tanks, etc.) visible during production. The visibility of the infrastructure would have the potential to adversely impact the scenic quality of the ACEC if it could not be mitigated. Applicant-committed BMPs for the site-specific use where appropriate of buried pipelines and centralized water and condensate tank facilities would reduce the visual impacts of pipelines and tanks.

Alternative C would disturb approximately 29 acres within potential habitat for the Uinta Basin hookless cactus (*Sclerocactus wetlandicus*). This is approximately 0.6% of the 5,167 acres of potential habitat in the project area and the ACEC. This is approximately 8 acres more of disturbance than would occur under the No Action Alternative. Alternative C would also disturb approximately 1 acre within the 0.5-mile buffer surrounding known raptor nests. Table 4-97 and Table 4-98 summarize the acres of impact to special status species and wildlife habitat under each alternative. Impacts to special status species are described more thoroughly in Section 4.12, Special Status Species.

4.11.1.3.3 Nine Mile Canyon ACEC

Development of well pads, roads, and associated features under Alternative C would disturb approximately 1,186 acres of the Nine Mile Canyon ACEC. This equals approximately 2.7% of the entire ACEC and 3.4% of the 34,653 acres within the ACEC in the project area.

Project-related development would disturb approximately 278 acres considered high-probability for the presence of cultural resources, or 2.9% of the 9,529 acres of high-probability areas present in that area of the ACEC that overlaps the project area. This is approximately 15 times as many acres of high-probability areas as would be disturbed under the No Action Alternative. However, the applicant-committed measures and BMPs described in Section 2.2.9.1 and Table 2-1 would greatly reduce the risk of adverse impacts, as described in Section 4.3, Cultural Resources.

Under Alternative C, 192 wells would be situated within 0.25 mile of the Nine Mile Canyon. This is 175 more wells than would be present under the No Action Alternative. These wells would create a short-term negative noise impacts to the scenic and recreational values of the Nine Mile Canyon ACEC during drilling. Daily productional noise impacts (from vehicle visits) within this same area are expected to be below 55 dBA, and would therefore not be likely to impact the area's recreational opportunities because noise levels below 55 dBA are not likely to interfere with recreational activities. The impacts of wells on recreation are discussed in more detail in Section 4.8, Recreation.

Alternative C would have 32 wells and 13 miles of roads within line of sight from Nine Mile Creek. This is approximately 32 times as many wells within line of sight as under the No Action Alternative. Most wells would have short-term negative impacts during drilling when the drilling rig is in place, but, through mitigation and removal of the drilling rig, they would likely not have major visual impacts during production. However, some well locations may have infrastructure (well pads, tanks, etc.) visible during production. The visibility of the infrastructure would have the potential to adversely impact the scenic quality of the ACEC if it could not be mitigated. Applicant-committed BMPs for the site-specific use where appropriate of buried pipelines and centralized water and condensate tank facilities would reduce the visual impacts of pipelines and tanks. Visual impacts are discussed more thoroughly in Section 4.14, Visual Resources and Section 4.8, Recreation.

Alternative C would disturb approximately 1,115 acres of potential habitat for the Uinta Basin hookless cactus (*Sclerocactus wetlandicus*) within the ACEC. This is approximately 0.3% of the 32,578 acres of potential habitat in the project area and the ACEC. This is nearly 11 times more acres of disturbance than would occur under the No Action Alternative. Alternative C would also disturb approximately 26 acres of the Badlands Cliff shrubby reed-mustard habitat area (approximately 1.8% of 1,449 acres within the Nine Mile Canyon ACEC), 0.3 acre of Graham's beardtongue habitat (out of 73 acres within the Nine Mile Canyon ACEC), and 219 acres of Untermann daisy habitat (out of 6,859 acres within the Nine Mile Canyon ACEC). As can be seen from Table 4-97, disturbance to shrubby reed-mustard, Graham's beardtongue, and Untermann daisy habitats is approximately 26, 0.3, and 192 more acres of disturbance, respectively, than would occur under the No Action Alternative. Impacts to special status species are described more thoroughly in Section 4.12, Special Status Species.

Project-related development would directly disturb areas designated as antelope, bighorn sheep, elk, and mule deer range in the Diamond Mountain RMP (BLM 1994). The acreages of these species' habitats that would be disturbed within the Nine Mile Canyon ACEC under Alternative C are shown in Table 4-98 in comparison to all other alternatives. Overall, Alternative C would have greater impact to wildlife habitat than any other alternative, though impacts to some individual habitat types may be less than under the Proposed Action. Additional indirect impacts to wildlife, such as habitat fragmentation, are detailed in Section 4.16, Wildlife.

4.11.1.3.4 Lower Green River Suitable Wild and Scenic River

Development of well pads, roads, and associated features under Alternative C would disturb approximately 36 acres of the proposed Lower Green River suitable WSR. This equals approximately 0.3% of the Lower Green River suitable WSR's entire 11,967 acres (see Table 4-99).

Project-related development would not directly disturb any riparian habitat or highly erodible soils. Impacts to riparian areas could occur through indirect means, such as invasion by noxious weeds from impacted adjacent upland areas. These weed impacts are more thoroughly analyzed in Section 4.13, Vegetation.

Under Alternative C, three wells would be situated within 0.25 mile of the Lower Green River suitable WSR. This is 1 more well than would be present in the same area as under the No Action Alternative (see Table 4-99). These wells would create a short-term negative impact from noise to the wild and scenic quality of the Lower Green River suitable WSR during drilling.

Daily productional noise impacts (from running wells and vehicle visits to well locations) within this same area are expected to be below 55 dBA, the level at which sounds are not likely to interfere with recreational activities and would therefore not be likely to impact the area's wild and scenic qualities.

Alternative C would have two wells and 0.9 mile of roads within line of sight from the Lower Green River (see Table 4-99). This is the same number wells within line of sight as under the No Action Alternative. Most wells would have short-term negative impacts during drilling when the drilling rig is in place, but they would likely not be seen during production because of mitigation and removal of the drilling rig. However, some well locations may have infrastructure (well pads, tanks, etc.) visible during production. The visibility of the infrastructure would have the potential to adversely impact the scenic quality of the WSR if it could not be mitigated. Because the suitable WSR is subject to valid existing rights these impacts may be allowed. However, the BLM would work with and subject to the agreement of holders of valid existing rights to modify proposed actions or activities to reduce the effect of the actions or activities on resource values and uses.

In addition, applicant-committed BMPs for the site-specific use where appropriate of buried pipelines and centralized water and condensate tank facilities would reduce the visual impacts of pipelines and tanks. Visual impacts are discussed more thoroughly in Section 4.14, Visual Resources.

4.11.1.4 Alternative D: No Action

4.11.1.4.1 Pariette Wetlands ACEC

Development of well pads, roads, and associated features under the No Action Alternative would disturb approximately 3 acres of the Pariette Wetlands ACEC. This equals approximately 0.03% of the ACEC's entire 10,437 acres and 0.06% of the ACEC's 4,859 acres within the project area. Overall, the No Action Alternative would have the least environmental impact of all alternatives.

Effects specific to the BLM's management objectives for the Pariette Wetlands ACEC may include surface disturbance to wetland and riparian habitat, sedimentation of water in Pariette Draw, and disturbance within potential habitat for the Uinta Basin hookless cactus (*Sclerocactus wetlandicus*).

Project-related development would not directly disturb any wetland or riparian habitat. However, indirect impacts to wetlands and riparian zones, such as invasion by noxious weeds, could occur. These types of impacts are more thoroughly analyzed in Section 4.13, Vegetation, and Section 4.15, Water Resources.

Analysis of disturbance within 0.25 mile of waterfowl habitat in the ACEC shows the No Action Alternative impacting approximately 1 acre. This is less than 0.1% of acreage within 0.25 mile of waterfowl habitat in the ACEC within the project area. Impacts related to the disturbance of wildlife habitat are discussed in more detail in Section 4.16, Wildlife.

Development under the No Action Alternative would not disturb any highly erosive soils in the Pariette Wetlands ACEC. Therefore, a measurable increase in sedimentation to Pariette Draw is not anticipated.

The No Action Alternative would disturb approximately 1.2 acres of potential habitat for the Uinta Basin hookless cactus and 1.4 acres of potential habitat for the Pariette cactus (*Sclerocactus brevispinus*). This is less than 0.1% of the 3,552 acres of Uinta Basin hookless cactus and 0.1% of Pariette cactus potential habitats in the project area and the ACEC. Under the No Action Alternative, there would be no direct impacts to the 2009 Pariette cactus core conservation areas. Impacts to special status species are described more thoroughly in Section 4.12, Special Status Species.

4.11.1.4.2 Lower Green River ACEC

Development of well pads, roads, and associated feature under the No Action Alternative would disturb approximately 17 acres of the Lower Green River ACEC. This equals approximately 0.2% of the ACEC's entire 8,470 acres and 0.6% of the ACEC's 3,090 acres within the project area.

Effects specific to the BLM's management objectives for the Lower Green River ACEC may include surface disturbance to riparian habitat, visual and noise impacts to the river's wild and scenic characteristics, disturbance within potential habitat for the Uinta Basin hookless cactus (*Sclerocactus wetlandicus*), impacts to special status fish species, and disturbance within a 0.5-mile buffer around raptor nests.

Project-related development would not directly disturb any riparian habitat or highly erodible soils. Impacts to riparian areas could occur through indirect means, such as invasion by noxious weeds from impacted adjacent upland areas. These weed impacts are more thoroughly analyzed in Section 4.13, Vegetation.

Under the No Action Alternative, 2 wells would be situated within 0.25 mile of the Green River, and construction noise (estimated to be 88 dBA 50 feet from source) would still be above 55 dBA (the level at which sounds are not likely to interfere with recreational activities) at river level (see Table 4-82.). The development of these wells would create a short-term negative impact from noise to the relevant and important values of the Lower Green River ACEC during drilling. Many special status animal species would avoid the area during construction and would travel greater distances to avoid the noise. Daily productional noise impacts (from running wells and vehicle visits to well location) within this same area are expected to be below 55 dBA, and would therefore not be likely to impact most species. Applicant-committed measures regarding raptors would mitigate impacts to any bald eagle roost sites in the ACEC, as described in Section 4.12, Special Status Species. The No Action Alternative would have five wells and 1 mile of roads within line of sight from the Lower Green River. Most wells would have short-term negative impacts during drilling when the drilling rig is in place, but they would largely not be seen during production because of mitigation and removal of the drilling rig. However, some well locations may have infrastructure (well pads, tanks, etc.) visible during production. The visibility of the infrastructure would have the potential to adversely impact the scenic quality of the ACEC if it could not be mitigated. Applicant-committed BMPs for the site-specific use where appropriate of buried pipelines and centralized water and condensate tank facilities would reduce the visual impacts of pipelines and tanks.

The No Action Alternative would disturb approximately 21 acres of potential habitat for the Uinta Basin hookless cactus. This is approximately 0.4% of the 5,167 acres of potential habitat in the project area and the ACEC. It would not disturb any areas within the 0.5-mile buffer surrounding known raptor nests. Impacts to special status species are described more thoroughly in Section 4.12, Special Status Species.

4.11.1.4.3 NINE MILE CANYON ACEC

Development of well pads, roads, and associated features under the No Action Alternative would disturb approximately 105 acres of the Nine Mile Canyon ACEC. This equals approximately 0.2% of the ACEC's entire 44,168 acres and 0.3% of the ACEC's 34,653 acres within the project area.

Effects specific to relevant values for the Lower Green River ACEC include surface disturbance impacts to cultural resources, visual and noise impacts to the area's recreational values, disturbance within potential habitat for the Uinta Basin hookless cactus (*Sclerocactus wetlandicus*) and the 0.5-mile buffer around raptor nests, and disturbance of other wildlife habitat.

Project-related development would disturb approximately 18 acres considered high-probability for the presence of cultural resources. This equals 0.2% of the 9,529 acres of high-probability areas present in the part of the ACEC that is within the project area. However, the applicant-committed measures and BMPs described in Section 2.2.9.1 and Table 2-1 would greatly reduce the risk of adverse impacts, as described in Section 4.3, Cultural Resources.

Under the No Action Alternative, 17 wells would be situated within 0.25 mile of the Nine Mile Canyon, which contains numerous roads, visited cultural sites, and other recreation areas. These wells would create a short-term negative noise impact to the scenic and recreational values of the Nine Mile Canyon ACEC during drilling because construction equipment noise levels could be up to 88 dBA 50 feet from the source. A recreationist would have to travel up to 0.5 mile from the source to reduce the noise levels below 55 dBA, the level at which sounds are not likely to interfere with recreational activities.

Daily productional noise impacts (from vehicle visits) within this same area are expected to be below 55 dBA, and would therefore not be likely to impact the area's recreational opportunities. The impacts of wells on recreation are discussed in more detail in Section 4.8, Recreation.

The No Action Alternative would have no wells or miles of roads within line of sight from Nine Mile Creek.

Development under the No Action Alternative would disturb approximately 103 acres within potential habitat for the Uinta Basin hookless cactus. This is approximately 0.3% of the 32,579 acres of potential habitat in the project area and the ACEC. Development would also disturb less than 1 acre of the Badlands Cliff shrubby reed-mustard habitat (or <0.1% of 1,449 acres within the Nine Mile Canyon ACEC) and approximately 27 acres of potential Untermann daisy habitat (out of 6,859 acres within the Nine Mile Canyon ACEC); no occupied Graham's beardtongue habitat would be impacted. See Table 4-97 for a comparison of impacts to special status species habitat under each alternative. Impacts to special status species are described more thoroughly in Section 4.12, Special Status Species.

Project-related development would directly disturb areas designated as antelope, bighorn sheep, elk, and mule deer range in the Diamond Mountain RMP (BLM 1994). The acres of these species' habitats that would be disturbed within the Nine Mile Canyon ACEC under the No Action Alternative are shown in Table 4-98. As can be seen from Table 4-98, the No Action Alternative would result in less impact to wildlife habitat than would any other alternative. Additional indirect impacts to wildlife, such as habitat fragmentation, are detailed in Section 4.16, Wildlife.

4.11.1.4.4 LOWER GREEN RIVER SUITABLE WILD AND SCENIC RIVER

Development of well pads, roads, and associated features under the No Action Alternative would disturb approximately 25 acres of the proposed Lower Green River suitable WSR. This equals approximately 0.2% of the Lower Green River suitable WSR's entire 11,967 acres.

Effects specific to the outstandingly remarkable values for the proposed Lower Green River WSR include visual and noise impacts and impacts to special status fish species.

Project-related development would not directly disturb any riparian habitat or highly erodible soils. Impacts to riparian areas could occur through indirect means, such as invasion by noxious weeds from impacted adjacent upland areas. These weed impacts are more thoroughly analyzed in Section 4.13, Vegetation.

Under the No Action Alternative, 2 wells would be situated within 0.25 mile of the Lower Green River suitable WSR (see Table 4-99). These wells would create a short-term negative impact from noise during drilling to the wild and scenic quality of the Lower Green River suitable WSR because construction equipment noise levels could be up to 88 dBA 50 feet from the source. A recreationist would have to travel 0.5 mile from the source to reduce the noise levels below 55 dBA, the level at which sounds do not interfere with the recreational activities. Daily productional noise impacts (from running wells and vehicle visits to well locations) within this same area are expected to be below 55 dBA, and would therefore not be likely to impact the area's recreational opportunities because noise levels below 55 dBA are not likely to interfere with recreational activities. The impacts of wells on recreation are discussed in more detail in Section 4.8, Recreation.

The No Action Alternative would have 2 wells and 0.3 mile of roads within line of sight from the Lower Green River. Most wells would have short-term negative impacts during drilling when the drilling rig is in place, but they would likely largely not be seen during production because of mitigation. However, some well locations may have infrastructure (well pads, tanks, etc.) visible during production. The visibility of the infrastructure would have the potential to adversely impact the scenic quality of the WSR if it could not be mitigated. Because the suitable WSR is subject to valid existing rights these impacts may be allowed. However, the BLM would work with and subject to the agreement of holders of valid existing rights to modify proposed actions or activities to reduce the effect of the actions or activities on resource values and uses.

In addition, applicant-committed BMPs for the site-specific use, where appropriate of buried pipelines and centralized water and condensate tank facilities, would reduce the visual impacts of pipelines and tanks. Visual impacts are discussed more thoroughly in Section 4.14, Visual Resources.

4.11.1.5 Alternative E: Reduced Development with Directional Drilling

4.11.1.5.1 Pariette Wetlands ACEC

Development of well pads, roads, and associated features under Alternative E would disturb approximately 0.4 acre of the Pariette Wetlands ACEC. No riparian habitat or highly erosive soils would be directly affected. Analysis of disturbance within 0.25 mile of waterfowl habitat in the ACEC shows Alternative E impacting no areas. This is 1 acre fewer than the number of disturbed acres under the No Action Alternative. Approximately 0.4 acre of potential habitat for Uinta Basin hookless cactus would be disturbed in the ACEC. No acres of Pariette cactus would be disturbed. There would be no direct impacts to the 2009 Pariette cactus core conservation areas.

4.11.1.5.2 Lower Green River ACEC

Development of well pads, roads, and associated features under Alternative E would disturb approximately 13 acres of the Lower Green River ACEC. This equals approximately 0.2% of the ACEC's entire 8,470 acres and 0.3% of the ACEC's 3,090 acres within the project area.

Project-related development would not directly disturb any riparian habitat or highly erodible soils. Impacts to riparian areas could occur through indirect means, such as invasion by noxious weeds from impacted adjacent upland areas. These impacts are more thoroughly analyzed in Section 4.13, Vegetation. Alternative E would have the same impact on riparian habitat as would the No Action Alternative.

Under Alternative E, three wells would be situated within 0.25 mile of the Green River. This is approximately 1.5 times as many wells as would be present under the No Action Alternative. These wells would create a short-term negative impact from noise during drilling to the relevant and important values of the Lower Green River ACEC because construction equipment noise levels could be up to 88 dBA 50 feet from the source. A recreationist would have to travel 0.5 mile from the source to reduce the noise levels below 55 dBA, the level at which sounds do not interfere with the recreational activities. Daily productional noise impacts (from running wells and vehicle visits to well locations) within this same area are expected to be below 55 dBA, and would therefore not be likely to impact the area's recreational opportunities. Applicant-committed measures regarding raptors would mitigate impacts to any bald eagle roost sites in the ACEC, as described in Section 4.12, Special Status Species.

Alternative E would have three wells and 1 mile of roads within line of sight of the Lower Green River. This is approximately 60% of the number of wells within line of sight as under the No Action Alternative. Most wells would have short-term negative impacts during drilling when the drilling rig is in place, but they would likely largely not be seen during production because of mitigation and removal of the drilling rig. However, some well locations may have infrastructure (well pads, tanks, etc.) visible during production. The visibility of the infrastructure would have the potential to adversely impact the scenic quality of the ACEC if it could not be mitigated. Applicant-committed BMPs for the site-specific use where appropriate of buried pipelines and centralized water and condensate tank facilities would reduce the visual impacts of pipelines and tanks.

Alternative E would disturb approximately 15 acres of potential habitat for the Uinta Basin hookless cactus (*Sclerocactus wetlandicus*). This is approximately 0.3% of the 5,167 acres of potential habitat in the project area and the ACEC. This is approximately 6 fewer acres of disturbance as would occur under the No Action Alternative. Alternative E would not disturb any areas within the 0.5-mile buffer surrounding known raptor nests. Impacts to special status species are described more thoroughly in Section 4.12, Special Status Species.

4.11.1.5.3 Nine Mile Canyon ACEC

Development of well pads, roads, and associated features under Alternative E would disturb approximately 120 acres of the Nine Mile Canyon ACEC. This equals approximately 0.3% of the ACEC's 44,168 acres and 0.4% of the ACEC's 34,653 acres within the project area.

Project-related development would disturb approximately 53 acres considered high-probability for the presence of cultural resources, or 0.6% of the 9,529 acres of high-probability areas present in the ACEC and within the project area. This is approximately 3 times as many high-probability acres as under the No Action Alternative. However, the applicant-committed measures and BMPs described in Section 2.2.9.1 and Table 2-1 would greatly reduce the risk of adverse impacts, as described in Section 4.3, Cultural Resources.

Under Alternative E, 16 wells would be situated within 0.25 mile of Nine Mile Canyon. The development of these wells would create a short-term negative noise impact during drilling to the relevant and important recreational values of the Nine Mile Canyon ACEC because construction equipment noise levels could be up to 88 dBA 50 feet from the source. A recreationist would have to travel 0.5 mile from the source to reduce the noise levels below 55 dBA, the level at which sounds are not likely interfere with the recreational activities. Daily production noise impacts (from vehicle visits) within this same area are expected to be below 55 dBA, and would therefore not be likely to impact the area's recreational opportunities. Impacts related to the impacts of wells on recreation are discussed in more detail in Sections 4.8, Recreation. Alternative E would have no wells or miles of roads within line of sight from Nine Mile Creek. This is the same number of wells within line of sight as under the No Action Alternative.

Alternative E would disturb approximately 116 acres of potential habitat for the Uinta Basin hookless cactus (*Sclerocactus wetlandicus*) within the ACEC. This is approximately 0.3% of the 32,578 acres of potential habitat in the project area and the ACEC. This is 13 more acres disturbance than would occur under the No Action Alternative. Alternative E would also disturb approximately 9 acres of the Badlands Cliff shrubby reed-mustard habitat area (or approximately 0.6% of 1,449 acres within the Nine Mile Canyon ACEC), 0 acres of Graham's beardtongue habitat (out of 73 acres within the Nine Mile Canyon ACEC), and 25 acres of Untermann daisy habitat (out of 6,859 acres within the Nine Mile Canyon ACEC). As can be seen in Table 4-97, disturbance to shrubby reed-mustard mustard habitat would be approximately 9 acres more than would occur under the No Action Alternative. Disturbance to potential Untermann daisy habitat would be approximately 2 acres less than would occur under the No Action Alternative. Impacts to special status species are described more thoroughly in Section 4.12, Special Status Species.

Project-related development would directly disturb areas designated as antelope, bighorn sheep, elk, and mule deer range in the Vernal RMP (BLM 2008c). The acres of these species' habitats that would be disturbed within the Nine Mile Canyon ACEC under Alternative E are shown in Table 4-98 in comparison to all other alternatives. Overall, Alternative E would have greater impact to wildlife habitat than would the No Action Alternative but less than would the Proposed Action. Additional indirect impacts to wildlife, such as habitat fragmentation, are detailed in Section 4.16, Wildlife.

4.11.1.5.4 LOWER GREEN RIVER SUITABLE WILD AND SCENIC RIVER

Development of well pads, roads, and associated features under Alternative E would disturb approximately 14 acres of the proposed Lower Green River suitable WSR (see Table 4-99). This equals approximately 0.11% of the Lower Green River suitable WSR's entire 11,967 acres.

Project-related development would not directly disturb any riparian habitat or highly erodible soils. Impacts to riparian areas could occur through indirect means, such as invasion by noxious weeds from impacted adjacent upland areas. These impacts are more thoroughly analyzed in Section 4.13, Vegetation.

Under Alternative E, three wells would be situated within 0.25 mile of the Lower Green River suitable WSR (see Table 4-99). This is approximately 1.5 times as many wells as would be present in the same area under the No Action Alternative. These wells would create a short-term negative impact from noise to the wild and scenic quality of the Lower Green River suitable WSR during drilling because construction equipment noise levels (estimated to be 88 dBA 50 feet from source) would still be above 55dBa (the level at which sounds are not likely to interfere with recreational activities) at river level (see Table 4-82.). A recreationist would have to travel 0.5 mile from the source to reduce the noise levels below 55 dBA, the level at which sounds are not likely interfere with the recreational activities. Daily productional noise impacts (from running wells and vehicle visits to well locations) within this same area are expected to be below 55 dBA, and would therefore not be likely to impact the area's wild and scenic qualities.

Alternative E would have two wells and 0.2 mile of roads within line of sight from the Lower Green River (see Table 4-99). This is the same number of wells within line of sight as under the No Action Alternative. Most wells would have short-term negative impacts during drilling when the drilling rig is in place, but they would likely not be seen during production because of mitigation and removal of the drilling rig. However, some well locations may have infrastructure (well pads, tanks, etc.) visible during production. The visibility of the infrastructure would have the potential to adversely impact the scenic quality of the WSR if it could not be mitigated. Because the suitable WSR is subject to valid existing rights these impacts may be allowed. However, the BLM would work with and subject to the agreement of holders of valid existing rights to modify proposed actions or activities to reduce the effect of the actions or activities on resource values and uses.

In addition, applicant-committed BMPs for the site-specific use where appropriate of buried pipelines and centralized water and condensate tank facilities would reduce the visual impacts of pipelines and tanks. Visual impacts are discussed more thoroughly in Section 4.14, Visual Resources.

4.11.1.6 ALTERNATIVE F: AGENCY PREFERRED ALTERNATIVE

4.11.1.6.1 PARIETTE WETLANDS ACEC

Development of well pads, roads, and associated features under Alternative F would not disturb any acres of the Pariette Wetlands ACEC. This is 3 acres fewer than the disturbed acres under the No Action Alternative. There would be no direct impacts to the 2009 Pariette cactus core conservation areas. Analysis of disturbance within 0.25 mile of waterfowl habitat in the ACEC shows Alternative F impacting no areas. However, indirect impacts to wetlands and riparian zones, such as invasion by noxious weeds, could occur. These types of impacts are more thoroughly analyzed in Section 4.13, Vegetation, and Section 4.15, Water Resources.

Alternative F development would not disturb any highly erosive soils in the Pariette Wetlands ACEC; therefore, a measurable increase in sedimentation to Pariette Draw is not anticipated.

4.11.1.6.2 LOWER GREEN RIVER ACEC

Development of well pads, roads, and associated features under Alternative F would not disturb any acres of the Lower Green River ACEC. Project-related development would not directly disturb any riparian habitat or highly erodible soils. Impacts to riparian areas could occur through indirect means, such as invasion by noxious weeds from impacted adjacent upland areas. These weed impacts are more thoroughly analyzed in Section 4.13, Vegetation. Alternative F would have the same impact on riparian habitat as would the No Action Alternative.

Under Alternative F, no wells would be situated within 0.25 mile of the Green River. This is fewer than the 2 wells that would be present under the No Action Alternative. Alternative F would have no wells and no miles of road within line of sight of the Lower Green River. This is less than the No Action Alternative (5 wells and 1 mile of road within line of sight of the Lower Green River).

There is no disturbance under Alternative F in the Lower Green River ACEC within potential habitat for the Uinta Basin hookless cactus (*Sclerocactus wetlandicus)*. This is 21 acres less than the disturbance that would occur under the No Action Alternative. Alternative F would not disturb any areas within the 0.5-mile buffer surrounding known raptor nests. Impacts to special status species are described more thoroughly in Section 4.12, Special Status Species.

4.11.1.6.3 NINE MILE CANYON ACEC

Development of well pads, roads, and associated features under Alternative F would disturb approximately 516 acres of the Nine Mile Canyon ACEC. This equals approximately 1.2% of the ACEC's 44,168 acres and 1.5% of the ACEC's 34,653 acres within the project area.

Project-related development would disturb approximately 58 acres considered high-probability for the presence of cultural resources, or 0.6% of the 9,529 acres of high-probability areas present in the ACEC and within the project area. This is approximately 3 times as many high-probability acres as under the No Action Alternative. However, the applicant-committed measures and BMPS described in Section 2.2.9.1 and Table 2-1 would greatly reduce the risk of adverse impacts, as described in Section 4.3, Cultural Resources.

Under Alternative F, 54 well pads would be situated within 0.25 mile of the Nine Mile Canyon rim. These wells would create a short-term negative noise impact during drilling to the scenic and recreational values of the Nine Mile Canyon ACEC because construction equipment noise levels could be up to 88 dBA 50 feet from the source. A recreationist would have to travel 0.5 mile from the source to reduce the noise levels below 55 dBA, the level at which sounds do not interfere with the recreational activities. Daily production noise impacts (from vehicle visits) within this same area are expected to be below 55 dBA, and therefore would not be likely to impact the area's recreational opportunities because noise levels below 55 dBA are not likely to interfere with recreational activities.

The impacts of wells on recreation are discussed in more detail in Section 4.8, Recreation. Alternative F would have no wells or miles of road within line of sight of Nine Mile Creek (the same as under the No Action Alternative).

Alternative F would disturb approximately 499 acres of potential habitat for the Uinta Basin hookless cactus (*Sclerocactus wetlandicus*) within the ACEC. This is approximately 1.5% of the 32,579 acres of potential habitat in the project area and the ACEC. This is 396 more acres of disturbance than would occur under the No Action Alternative. Alternative F would also disturb approximately 32 acres of the Badlands Cliff shrubby reed-mustard habitat area (or approximately 2% of 1,449 acres within the Nine Mile Canyon ACEC), 0 acres of Graham's beardtongue habitat (out of 73 acres within the Nine Mile Canyon ACEC), and 170 acres of Untermann daisy habitat (out of 6,859 acres within the Nine Mile Canyon ACEC). As can be seen from Table 4-97, this disturbance is approximately 31, 0, and 143 more acres of disturbance, respectively, than would occur under the No Action Alternative. Impacts to special status species are described more thoroughly in Section 4.12, Special Status Species.

Project-related development would directly disturb areas designated as antelope, bighorn sheep, elk, and mule deer range in the Vernal RMP (BLM 2008c). The acres of these species' habitats that would be disturbed within the Nine Mile Canyon ACEC under Alternative F are shown in Table 4-98 in comparison to all other alternatives. Overall, Alternative F would have greater impact to wildlife habitat than would the No Action Alternative, but less than would the Proposed Action. Alternative F would disturb four acres within the 0.5-mile buffer surrounding known raptor nests. Additional indirect impacts to wildlife, such as habitat fragmentation, are detailed in Section 4.16, Wildlife.

4.11.1.6.4 Lower Green River Suitable Wild and Scenic River

Development of well pads, roads, and associated features under Alternative F would not disturb any acres of the proposed Lower Green River suitable WSR (see Table 4-99).

Alternative F would have no wells and 0.6 mile of roads within line of sight from the Lower Green River (see Table 4-99). This is fewer wells within line of sight than under the No Action Alternative. Visual impacts are discussed more thoroughly in Section 4.14, Visual Resources.

Project-related development would not directly disturb any riparian habitat or highly erodible soils. Impacts to riparian areas could occur through indirect means, such as invasion by noxious weeds from impacted adjacent upland areas. These weed impacts are more thoroughly analyzed in Section 4.13, Vegetation.

4.11.2 Mitigation

Proposed mitigation measures that could be applied to reduce the impacts to special designations include the following:

- Drilling would be limited seasonally, as necessary based on site-specific review, to minimize disturbance of wildlife, waterfowl, and special status species of particular value within each ACEC.
- Vegetative screening and camouflage paint would be used hide or mask production facilities to minimize the impact to the wild and scenic quality of the Lower Green River suitable WSR and ACEC, and the scenic quality of other ACECs.

- During the APD processing and as feasible, the Operator and AO would: jointly determine the use of topographic features to serve as visual screens; place facilities away from highly visible points such as ridgelines; use low-profile tanks to reduce visibility where taller tanks would be more visible; and avoid excessive side-casting of earth materials from ridgelines and steep slopes.
- Placement of tanks and drilling pads would be considered and off-site tanks may be used to minimize visual impacts.
- As feasible on a site-specific basis, off-site tanks or centralized tank batteries would be used at production locations to reduce visual impacts.
- Where feasible, directional drilling would be used in order to reduce or avoid impacts to the ACEC relevant values.
- Where feasible, directional drilling would be used to avoid development in wetland and riparian areas.

4.11.3 Unavoidable Adverse Impacts

Unavoidable adverse impacts include increases in the number of acres of disturbance to special status species' habitat within several existing and potential ACECs and reduction of noise-free and scenic qualities within the Nine Mile Canyon ACEC, and Lower Green River suitable WSR.

4.11.4 Irretrievable and Irreversible Commitments of Resources

With proper mitigation and remediation, most special management area resources and values would have no projected irretrievable commitments of resources. The only potential irretrievable commitments of resources would be a reduction of noise-free and scenic qualities within the Nine Mile Canyon ACEC, and Lower Green River suitable WSR; reduction of riparian and waterfowl habitat in Pariette Wetlands ACEC; and disturbance of special status plant species habitat within several ACECs. These resources would be impacted irretrievably because during the project time period, the resources would be affected regardless of mitigation. Once the project is over, these resources can be reclaimed. The only irreversible commitment of resources is disturbance to cultural resources within the Nine Mile Canyon ACEC. Damage to cultural resources is considered irreversible because resource damage is often permanent.

4.11.5 Relationship of Short-term Uses to Long-term Productivity

Short-term uses related to well development could impact the long-term values of special management areas in the following ways: direct disturbance to relevant values through removal of riparian resources, disturbance of special status species and wildlife habitat, disturbance and/or irreversible loss of cultural resources, and loss of scenic quality. However, the impacts of well development are not expected to adversely affect the long-term productivity of the special management area resources and values. During the extraction phase of the project, impacts would continue for the life of the project, but because the level of impact to special management area values is low and most impacts would be reclaimed, long-term productivity would not be substantially impacted.

4.12 SPECIAL STATUS SPECIES

This section considers the environmental consequences of the Proposed Action and four other alternatives to 13 federally listed or candidate species, 19 State of Utah/BLM sensitive species, and raptors and migratory birds within the project area. The federally listed or candidate species include six plants, three birds, and four fish. Species listed as sensitive by the State of Utah and the BLM include seven plant, three mammals, six birds, and three fish. Special status species have limited distributions or numbers, generally with specific habitat requirements. Thus, if they are displaced or their habitat is altered, it may not be possible to relocate or reestablish them elsewhere. Impacts to special status species must therefore be viewed in the context of those individual factors that are most important to managing individual species for either recovery or to prevent their listing as threatened or endangered. It is important to note that mortality of threatened or endangered species would be reduced and avoided to the maximum degree possible through conservation measures for all species. If occupied habitat cannot be avoided, the applicant and the BLM will work with the U.S. Fish and Wildlife Service (USFWS) to minimize and mitigate impacts to the species.

Potential direct adverse effects of the Gasco Energy Field Development could include

- disturbance of habitat suitable to special status species or potential habitat necessary for their recovery;
- disruption of breeding, nesting, and roosting of birds due to construction, drilling, and other human activities (including poaching); and
- reduction of water quality and quantity in special status fish habitat due to flow depletion.

Indirect adverse impacts could include

- damage to special status species' habitat by unauthorized off-road traffic;
- disruption of birds' migration, activity patterns and timing, and plants' seed dispersal and pollination due to increased road density and human activity;
- sedimentation and an increased chance of contamination of the Upper Colorado River drainage system by accidental spillage of oil and gas products; and
- increased habitat fragmentation and an increased risk of the subsequent displacement of individuals.

Because this is a programmatic-level EIS, the impacts to special status species described in this chapter are general and comparative in nature. Site-specific well, road, and facility placements are not identifiable at this time. As each individual project application is received, site-specific assessments would occur to more accurately estimate the impacts of specific future actions and facilities on special status species in the project area and help identify which mitigation measures are appropriate.

Direct impacts to federally listed species would constitute a "take," defined by the ESA as "harming, hunting, wounding, killing, or harassment." Harassment includes activities resulting in increased stress during critical life history stages such as nesting, migration, or wintering; loss or degradation of designated or proposed critical habitat; loss or degradation of occupied or potential listed species' habitat; or activities precluding or reducing the effectiveness of recovery goals or measures. The terms used here to describe special status species' habitats are defined below.

- *Potential habitats* are areas that satisfy the broad criteria of the species habitat description; usually determined by preliminary, in-house assessment.
- *Suitable habitats* are areas that exhibit the specific habitat features necessary for species' persistence, as determined by field inspection and/or surveys, but that may or may not contain the species.
- *Occupied habitats* are any areas within 300 feet of a listed plant individual.
- *Designated or proposed critical habitats* are habitats that have been deemed essential for the conservation of a threatened, endangered, or candidate species and that may require species management and protection under Section 4 of the ESA.
- *Core conservation areas* are the cactus habitat areas that would be necessary for recovery of the Pariette cactus. The core conservation areas referred to in this document are those developed in 2009 as a result of the Castle Peak/Eightmile Flat EIS consultation (referred to hereafter in this document as the 2009 core conservation area).

The State of Utah/BLM sensitive species are not regulated under the ESA; however, analysis and determination of effects are included for sensitive species to determine if proposed actions could contribute to the need to list them under the ESA.

4.12.1 Direct and Indirect Effects

4.12.1.1 Alternative A: Proposed Action

4.12.1.1.1 Federally Listed Threatened, Endangered, and Candidate Species

4.12.1.1.1.1 Impacts Common to Several Species

The construction of roads, well pads, evaporation ponds, and ancillary features under the Proposed Action would increase road densities in and around the habitat of special status plant species, reduce their available habitat, and increase the fragmentation of their habitat. Increased road densities would enhance OHV access to currently remote areas and would facilitate increased illegal collection of rare plants. Loss of individuals, populations, and habitat, should it occur, would be a long-term adverse impact given the limited populations and abundance of these plant species, and the long-lasting effects of habitat disturbance, weed infestation, and soil erosion. Habitat fragmentation and loss would further the genetic isolation of populations of special status species and the loss of biodiversity in and around the project area. Adverse impacts to seed dispersal and pollination of special status plants are also possible, although too poorly documented to quantify. Surface disturbance adversely affects pollinators and their nesting and foraging habitats by removing ground nesting sites and by reducing plant cover and forage. Removal and degradation of bee habitats negatively impacts special status plant species by reducing the diversity and abundance of pollinators and, thereby, the plant's ability to successfully reproduce. In addition, the fragile soils in which most of the project area's special status plant species grow are highly susceptible to wind erosion, and surface disturbances increase the potential for soil erosion. Deposition of wind-blown soil on the listed plant species potentially affects plant reproduction, and is currently a problem in existing oil and gas fields (BLM 2006b). Because dust can reduce photosynthesis and productivity in desert plants (Sharifi et al. 1997), it would have a negative impact of unknown magnitude and spatial extent on plants in the project area. The pollination vectors for the special status plant species in the project area are poorly understood. Seed-dispersal vectors are also unknown within the project area; however, population fragmentation due to road development would affect both. Inventories will be conducted on a site-specific basis to determine if special status plant species or their habitats are present, with 100% avoidance where the plant occurs (see Appendix B).

Two federally protected bird species occur in the project area: the threatened Mexican spotted owl (MSO) and the western yellow-billed cuckoo, a candidate for listing under the ESA. Special status bird species are particularly sensitive to disturbance surrounding nesting and roosting sites, the effects of herbicides and other chemicals, and vehicle strikes while feeding on roads. Other potential impacts include direct mortality of young and eggs during construction, loss of breeding sites, loss of foraging habitat, and displacement from habitat. Applicant-committed measures and BMPs would help avoid direct impacts, and lessen indirect impacts. In addition, regulatory requirements and BLM policy guidelines require that well pads and associated roads and pipelines be located to avoid or minimize impacts to sensitive species habitats (see Section 2.1). Temporal and spatial nest buffers for individual species are described in species sections below.

4.12.1.1.1.2 Clay Reed-mustard

As proposed, no occupied or suitable clay reed-mustard habitat areas (USFWS 2010c, habitat polygons) would be directly impacted by implementation of the Proposed Action (see Map 37). In addition, pre-project habitat assessments to identify suitable clay reed-mustard habitat will be completed in 100% of proposed disturbance areas under all alternatives. Where suitable habitat occurs, site inventories will be conducted to determine if the species is present, with 100% avoidance where the plant occurs (see Appendix B).

Therefore, of the potential impacts to special status plant species discussed above, only indirect and dispersed direct impacts impacts would occur under the Proposed Action. Potentially adverse impacts to clay reed-mustard could include minor deposition of wind-blown soil that could slightly reduce the viability of individual plants, and increased risk of noxious weeds from introduction in areas adjacent to occupied or suitable habitat. However, applicant-committed measures to inventory and treat noxious weeds along all project-related disturbance areas and control dust (through gravelling roads or water) that could impact special status plants would further reduce the risk of indirect impacts.

Clay Reed-mustard Determination (Proposed Action)

Implementation of the Proposed Action may affect, but is not likely to adversely affect the species.

Rationale for Clay Reed-mustard Determination (Proposed Action)

Under the Proposed Action, no direct impacts to occupied or suitable clay reed-mustard habitat or plants would occur due to applicant-committed measures. Due to applicant-committed measures including weed treatment, dust mitigation, and avoidance of occupied habitat, limited indirect impacts are not anticipated within the 1,231 acres of occupied or suitable habitat within the project area (6% of the species' total occupied or suitable habitats). A habitat assessment will be completed across 100% of disturbance areas to identify suitable habitats, with site inventories conducted within suitable habitats to determine occupancy and 100% avoidance of occupied habitat. Based on this analysis as well as conservation and applicant-committed measures, the BLM has determined that the Proposed Action would not be likely to adversely affect the species.

4.12.1.1.1.3 Shrubby Reed-mustard

Shrubby reed-mustard is known to occur discontinuously across a 1,449-acre portion of the project area, identified in 1994 Recovery Plan as the Badlands Cliff shrubby reed-mustard habitat area (USFWS 1994b; Map 37). Approximately 27 acres (1.9%) of the Badlands Cliff shrubby reed-mustard habitat area would be disturbed under the Proposed Action. However, no plants or occupied habitat would be impacted due to applicant-committed conservation measures (Appendix B) as described below. Table 4-100 provides a comparison of the number acres of shrubby reed-mustard habitat directly impacted by each alternative.

Table 4-100. Direct Impact of Shrubby Reed-mustard Habitats* in the Project Area under Each Alternative

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Acres disturbed	27	19	26	<0.1	9	32
Percentage disturbed	1.9%	1.3%	1.8%	≤0.01%	0.6%	2.5%
Habitat acreage within 300 feet of roads	271	174	258	108	111	296

*Comprises the Badlands Cliff shrubby reed-mustard habitat area as identified in the 1994 Recovery Plan (1994b). No occupied habitat would be impacted due to applicant-committed conservation measures.

Although 27 acres of the Badlands Cliff shrubby reed-mustard habitat area would be disturbed under the Proposed Action (approximately 27 more acres than under the No Action Alternative), no development will occur within occupied habitat (defined as any area within 300 feet of known shrubby reed-mustard individuals. The applicant-committed measures described in Appendix B would eliminate direct impacts to occupied habitat or to individual plants. Under all alternatives, pre-project habitat assessments to identify suitable shrubby reed-mustard habitat will be completed in 100% of proposed disturbance areas. Where suitable habitat occurs, site inventories will be conducted to determine if the species is present, with 100% avoidance and a 300-foot buffer established where the plant occurs (see Appendix B).

Indirect impacts would generally be the same as described in Section 4.12.1.1.1.2 for clay reed-mustard. However, project-related disturbance in and near shrubby reed-mustard habitat would increase the potential for adverse indirect impacts from weed invasion, fugitive dust, and habitat fragmentation for the species and its pollinators and seed dispersers. As shown above in Table 4-100, 271 acres of the Badlands Cliff shrubby reed-mustard habitat area occurs within 300 feet of existing and proposed roads, and is assumed to therefore be at greater risk of weed and cheatgrass invasion (Bradley and Mustard 2006). However, applicant-committed measures to inventory and treat noxious weeds (as directed by AO) along all project-related disturbance areas and control dust (through gravelling roads or water) that could impact special status plants would further reduce the risk of indirect impacts. For the purposes of this analysis, this acreage would be at increased risk for the indirect impacts listed above. This represents 163 more acres than the No Action Alternative.

Shrubby Reed-mustard Determination (Proposed Action)

Implementation of the Proposed Action **may affect, and is likely to adversely affect** the species.

Rationale for Shrubby Reed-mustard Determination (Proposed Action)

No development will occur within occupied habitat (i.e., within 300 feet of known shrubby reed-mustard individuals). Applicant-committed measures (Appendix B) including habitat assessments across 100% of disturbance areas to identify suitable habitats, site inventories to determine occupancy, and 100% avoidance of occurrence areas would would effectively eliminate the risk of direct physical damage to individual plants or occupied habitat. Surface disturbance under the Proposed Action would directly affect less than 2% of the Badlands Cliff shrubby reed-mustard habitat area, which is located entirely within the project area. Indirect and dispersed direct impacts such as an increased risk of weeds would likely occur over 271 acres (18.7%) of the Badlands Cliff shrubby reed-mustard habitat area, and would largely be mitigated by applicant-committed measures. Applicant-committed measures to inventory and treat noxious weeds along all project-related disturbance areas and control dust (through gravelling roads or water) that could impact special status plants would reduce these risks. However, because this alternative would disturb suitable habitat and increase the risk of noxious weeds that could render this habitat unsuitable, it is likely to reduce the suitable habitat available for the species' recovery. Based on this analysis, the BLM has determined that the Proposed Action would be likely to adversely affect the species.

4.12.1.1.1.4 Pariette Cactus

The defined potential habitat of the Pariette cactus (*Sclerocactus brevispinus*) overlaps approximately 2,010 acres in the northeast corner of the project area (USFWS 2011a; Map 37). In addition, the species is known to co-occur with Uinta Basin hookless cactus (*Sclerocactus wetlandicus*) at the mouth of Pariette Draw (USFWS 2007a), and therefore has potential to occur within Uinta Basin hookless cactus occurrence areas within the project area, including to the south and east of the known habitat in the project area (personal communication between Greg Larson, SWCA, and Bekee Megown, USFWS, 2007), although this is not defined as potential habitat.

The Proposed Action would not directly impact any of the 2,010 acres of potential Pariette cactus habitat through the development of roads, well pads, or other related facilities. Under the Proposed Action, there would be no direct impacts to Pariette cactus core conservation areas developed in 2009 as a result of the Castle Peak/Eightmile Flat EIS consultation (referred to hereafter in this document as the 2009 core conservation area, Table 4-101) due to habitat removal during construction and maintenance activities. The 2009 core conservation areas do not exclusively contain occupied Pariette cactus habitat (i.e., areas within 300 feet of a listed plant individual), but also contain potential or suitable habitats for the species' pollinators or other habitat associates. However, because Pariette cactus requires insect pollinators for successful reproduction (Tepedino et al. 2010), impacts to pollinator nesting and foraging habitats within the 2009 core conservation areas would negatively affect Pariette cactus by reducing the diversity and abundance of pollinators and thereby, the plant's ability to successfully reproduce. Because there is little or no information regarding the distances that Pariette cactus' pollinators travel from their nesting habitats to forage, it is not currently possible to define a habitat buffer distance that will protect these cactus species, their pollinators, and the pollinators' habitats. The following applicant-committed measures would minimize direct impacts to potential habitats and all habitat within the 2009 core conservation areas in the project area: cactus surveys will be conducted within 300 feet of all surface disturbance across all project areas within the potential habitat polygon and the 2009 core conservation areas; project area disturbance outside of the potential habitat polygon and the 2009 core conservation areas will be evaluated by the BLM AO for suitable habitat, and surveys will be conducted if necessary. In cooperation with the BLM, the USFWS has developed a landscape-level, long-term monitoring program for both *Sclerocactus* species across their ranges in the Uinta Basin. Although the protocol is still being refined, it is hoped that the effects of development from this and other projects will be better understood on a broad scale, allowing the USFWS to develop and implement more effective recovery measures for the species (see Appendix B). Nevertheless, potential and suitable habitats could be indirectly impacted by fugitive dust and erosion from road and well-pad development, illegal collection, and OHV access facilitated by increased road densities, proliferation of noxious weeds, and direct and indirect impacts to the species' pollinators and seed dispersers. However, 598 acres of potential Pariette cactus habitat and 24 acres of the 2009 core conservation areas occur within 300 feet of existing and proposed roads or other surface disturbances where there would be increased potential for indirect impacts (Table 4-101). Indirect impacts would be mitigated by applicant-committed measures to control noxious weeds and control fugitive dust where dust could impact threatened and endangered plants (Appendix B). USFWS and BLM are currently in the process of developing new core conservation areas for the cactus. When the new Pariette cactus core conservation areas and management for those areas are finalized, under all alternatives and in accordance with the Pariette cactus conservation measures (Appendix B), additional measures to avoid or minimize effects to the species may be developed and implemented in consultation with the USFWS to ensure compliance with the ESA.

Table 4-101. Surface Disturbance and New Roads within the Pariette Cactus's Potential Habitat* and 2009 Core Conservation Areas in the Project Area under Each Alternative**

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Acres potential habitat disturbed	0	0	27	6	0	0
Miles of new roads within potential habitat	0	0	0.3	1.5	0	0
Potential habitat acreage within 300 feet of roads	598	598	621	602	597	579
Acres (%) 2009 core conservation area disturbed	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
2009 Core conservation area acreage within 300 feet of roads	23.6	23.6	23.6	23.6	23.6	23.6

* Includes all potential habitat in the project area, as defined in Section 3.12.1.1.2.
** 2009 core conservation areas are those developed as a result of the Castle Peak/Eightmile Flat EIS consultation.

Pariette Cactus Determination (Proposed Action)

Implementation of the Proposed Action **may affect, but is not likely to adversely affect** the species.

Rationale for Pariette Cactus Determination (Proposed Action)

The Proposed Action would not directly impact occupied habitat, potential habitat, or the 2009 core conservation area acreages for the Pariette cactus habitat. Approximately 598 acres of potential Pariette cactus habitat and 24 acres of core conservation areas within 300 feet of existing and proposed roads would be vulnerable to indirect impacts, but these would be mitigated by applicant-committed measures. In addition, indirect impacts and the risk of direct impacts outside of potential habitat would be effectively mitigated by applicant-committed measures. Based on this analysis, as well as conservation and applicant-committed measures, the BLM has determined that the Proposed Action would not be likely to adversely affect the species.

4.12.1.1.1.5 Uinta Basin Hookless Cactus

The Uinta Basin hookless cactus (*Sclerocactus wetlandicus*) is found discontinuously within extensive potential habitat totaling approximately 98,417 acres within the project area (see Map 37). These habitats consist of benches above the the Green River, previously delineated polygons at the base of the Badland Cliffs (BLM 2002c), and occupied habitat (i.e., those areas within 300 feet of a listed plant individual) documented from recent surveys within the project area (USFWS 2011 habitat polygon). The Proposed Action would result in the disturbance of 4,089 acres, or 4.2%, of potential habitat in the project area. Development under the Proposed Action would disturb approximately 3,125 more acres (or 3.2 times more) Uinta Basin hookless cactus habitat than under the No Action Alternative. It would also result in 68 more miles of road (or 1.7 times more) than would the No Action Alternative, effectively placing 26,410 acres of the cactus's potential habitat within 300 feet of existing and proposed roads, and therefore at a greater risk for invasion by weeds and invasive species such as cheatgrass (Bradley and Mustard 2006). This alternative would place 9,001 more acres of habitat near a road than the No Action Alternative. Table 4-102 provides a comparison of the number of acres of Uinta Basin hookless cactus for each alternative.

Table 4-102. Surface Disturbance and New Roads within the Uinta Basin Hookless Cactus Potential Habitats* in the Project Area under Each Alternative

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Acres disturbed	4,089.3	2,674.0	4,829.9	974.1	1,096.9	499
Percentage disturbed	4.2%	2.7%	4.9%	1.0%	1.1%	0.9%
Miles of new roads	162.2	106.3	210.3	94.0	49.7	92
Habitat acreage within 300 feet of roads	26,410.4	22,663.5	30,493.7	17,409.0	18,749.8	21,581

*Includes all potential habitat in the project area, as defined in Section 3.12.1.1.2.

As with other special status plant habitats, areas disturbed under the Proposed Action and areas adjacent to disturbed sites would be susceptible to invasion by noxious weeds, as described in Section 4.13.1.1.2. Disturbance areas and surrounding habitats would also be subject to indirect impacts to population connectivity due to the effects of habitat fragmentation on pollinator and/or seed-disperser movement and availability.

Additional indirect impacts to Uinta Basin hookless cactus include an increased risk of crushing by OHVs due to an expanded road network in the project area, impacts from herbicides used to control invasive plants in the project area, and possible reductions in pollination or seed dispersal due to a larger road network and resulting habitat fragmentation and dust. Because Uinta Basin hookless cactus requires insect pollinators for successful reproduction (Tepedino et al. 2010), impacts to pollinator nesting and foraging habitats would negatively affect the cactus by reducing the diversity and abundance of pollinators and, thereby, the plant’s ability to successfully reproduce. Indirect impacts would occur along approximately 162 miles of new roads within potential habitat under the Proposed Action. Deposition of wind-blown soil onto the cactus during construction and use of these roads would also negatively impact the cactus through reduced photosynthesis (BLM 2006b). The expanded road network and surface disturbance from project-related construction would also increase sediment delivery to the small ephemeral drainages and areas of overland flow associated with Uinta Basin hookless cactus. The Uinta Basin hookless cactus is not tolerant of heavy sedimentation (BLM 2006b), and increased sedimentation would increase the risk of mortality or stress to an unspecified number of Uinta Basin hookless cactuses located near disturbed areas.

Assuming an average plant density of 1.56 plants/acre based on numerous block surveys and transects conducted in the project area (unpublished SWCA data), the 4,089 acres of surface disturbance proposed in the cactus's potential habitat under the Proposed Action could contain approximately 6,379 plants (Table 4-103). Including desiccants, or dead cacti that still have tissue visible, up to 8,342 plants may be located in areas proposed for development. In addition, approximately 3,640 spine clusters (dead cacti that have no tissue, and have probably been dead greater than 2 years) would be located in areas proposed for development under the Proposed Action. Both desiccants and spine clusters are afforded protection by the ESA because the species' seeds get trapped by the spines and the locations are therefore considered occupied habitat.

These plants would be avoided to the extent possible through the applicant-committed measures described for Uinta Basin Hookless cactus contained in Appendix B, which include: cactus surveys will be conducted within 300 feet of all surface disturbance across all project areas within the potential habitat polygon; project area disturbance outside of the potential habitat polygon will be evaluated by the BLM AO for suitable habitat and surveys will be conducted if necessary. In cooperation with the BLM, the USFWS has developed a landscape-level, long-term monitoring program for both *Sclerocactus* species across their ranges in the Uinta Basin. Although the protocol is still being refined, it is hoped that the effects of development from this and other projects will be better understood on a broad scale, allowing the USFWS to develop and implement more effective recovery measures for the species. Nevertheless, due to circumstances where individual plants could not be avoided without unduly constraining operations or impacting other sensitive resources, a number of plants may be directly impacted under the Proposed Action. When individual plants cannot be avoided without unduly constraining operations or impacting other sensitive resources, the applicant will work with the BLM and the USFWS to develop additional conservation measures to prevent loss of individual plants. Salvage and translocation of cacti is not a viable conservation measure, and adherence to current conservation measures including avoidance of occupied habitat will be followed. Translocated cacti are currently considered lost to the population. Finally, the project area overlaps portions of suitable and potential Uinta Basin hookless cactus habitat for which the USFWS and BLM are currently developing core conservation areas to further recovery efforts for the species. When the cactus core conservation areas and management for those areas are finalized, in accordance with the Uinta Basin hookless cactus conservation measures (Appendix B), additional measures to avoid or minimize effects to the species may be developed and implemented in consultation with the USFWS to ensure compliance with the ESA. These conservation measues would apply under all alternatives.

Table 4-103. Number of Uinta Basin Hookless Cactus Potentially Located in Areas Proposed for Development under Each Alternative

	Average Number per acre*	Alternative A Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Plants	1.56	6,379	4,171	7,535	1,520	1,711	778
Plants and Desiccants	2.04	8,342	5,455	9,853	1,987	2,238	1,018
Spine Clusters	0.89	3,640	2,380	4,299	867	976	444

* From unpublished SWCA surveys of 23 quarter-quarter sections of the Uinta Basin hookless cactus' potential habitats within the project area.

Approximately 162 miles of road would be constructed in the cactus's potential habitat under the Proposed Action leading to direct and indirect impacts to the cactus and its pollinators and/or seed dispersers. Impacts include increased stress or mortality of the cactus and its insect pollinators and/or seed dispersers from fugitive dust; the introduction of invasive weeds, leading to increased competition, alteration, or elimination of cryptobiotic soil crusts as well as alteration of habitat structure, reduced diversity, and reduced population connectivity; and limited accessibility to pollinators and seed dispersers due to habitat fragmentation. However, applicant-committed measures to inventory and treat noxious weeds along all project-related disturbance areas and control dust as necessary (through gravelling or watering roads) to mitigate impacts to special status plants would greatly reduce the risk of indirect effects from noxious weeds and dust. The expanded road network resulting from implementation of the Proposed Action would increase the risk of illegal collecting of the Uinta Basin hookless cactus, which is one of its primary threats. According to the USFWS (1990c, 2006c, 2007a), the cactus is highly prized by collectors, and has been commercially collected in the past.

Uinta Basin Hookless Cactus Determination (Proposed Action)

Implementation of the Proposed Action **may affect, and is likely to adversely affect** the species.

Rationale for Uinta Basin Hookless Cactus Determination (Proposed Action)

There is potential for direct and indirect adverse impacts to individuals, habitat, pollinators, and seed dispersers in spite of applicant-committed conservation measures. An estimated 6,379 plants would require avoidance measures to prevent direct impacts by project-related disturbances. However, a number of cacti that could not be avoided operationally would be directly impacted. This number, as identified through future consultation with USFWS, would not be allowed to reach a level that would imperil the species, per the ESA. Impacts that could not be avoided would be mitigated though measures identified during consultation. The total estimate of plants that may be directly affected would likely represent fewer than 1%–2% of the total estimated population of 30,000 individuals. Based on this analysis, the BLM has determined that the Proposed Action would likely adversely affect the species.

4.12.1.1.1.6 Graham's Beardtongue

Development proposed under the Proposed Action would disturb 0.5 acre (0.6%) of occupied Graham's beardtongue habitat (86 acres) in the project area (see Map 37). Approximately 16.2 acres of Graham’s beardtongue occupied habitat would be effectively located within 300 feet of existing and proposed roads under this alternative, and therefore at greater risk of indirect adverse impacts such as the invasion of non-native species. Table 4-104. provides a comparison of the number of acres of occupied Graham's beardtongue habitat directly impacted by each alternative.

Table 4-104. Surface Disturbance of Graham's Beardtongue Occupied Habitat in the Project Area under Each Alternative

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Acres disturbed	0.5	0.5	0.5	0	0	0
Percentage disturbed	0.6%	0.5%	0.5%	0%	0%	0%
Habitat acreage within 300 feet of roads	16.2	16.2	16.2	16.2	16.2	16.2

Adverse impacts associated with an increased risk of weeds would also adversely impact the species, and could include increased competition for nutrients, water, and light, and weed-induced alteration of habitat structure and composition. These effects would reduce the suitability of the habitat, and could ultimately lead to population declines due to the exclusion or extirpation of the species. However, applicant-committed measures to inventory and treat noxious weeds along all project-related disturbance areas would greatly reduce the risk of weed invasion. Additional adverse impacts to Graham's beardtongue would include an increased risk of surface disturbance or crushing of individual plants from OHV use along the expanded road network in the project area; impacts from herbicides used to control invasive plants in the project area; and possible reductions in pollination or seed dispersal due to habitat fragmentation and fugitive dust associated with the proposed development. These impacts would occur on 0.5 acre more than under the No Action Alternative. Conservation measures specific to the application of herbicides near special status plants would minimize the risk of inadvertent herbicide impacts. Site-specific surveys would occur under all alternatives. When individual plants cannot be avoided without unduly constraining operations or impacting other sensitive resources, the applicant will work with the BLM and the USFWS to develop additional conservation measures to prevent loss of individual plants.

Graham's Beardtongue Determination (Proposed Action)

Implementation of the Proposed Action **is not likely to jeopardize the continued existence of the species, and is not likely to destroy or adversely modify proposed critical habitat.**

Rationale for Graham's Beardtongue Determination (Proposed Action)

Less than 0.5% of the available habitat for the species in the project area would be directly impacted under any alternative and 100% avoidance of occupied habitat would be required. In addition, the project area encompasses only a small (<5%) portion of the far west side of the Graham's beardtongue's occupied habitat, so overall impacts across the species' range under each alternative would be negligible.

4.12.1.1.1.7 Ute Ladies'-tresses

As discussed in Section 3.12.1.1.4, there is limited potential for the occurrence of Ute ladies'-tresses along riparian corridors of the Green River and Nine Mile Canyon within the project area. It is possible that any potential habitats could coincide with 11 acres of proposed disturbance within riparian areas; however, habitat surveys for the species would be required as part of the permitting process for any wetland impacts under the Clean Water Act (Section 404). In addition, direct impacts to the orchid would be minimized by preliminary habitat assessments conducted throughout project disturbance areas, site inventories conducted in suitable habitat, and avoidance and conservation measures implemented in occupied habitats. Based on these applicant-committed measures, direct impacts to occupied habitats of the Ute ladies'-tresses would not occur.

Weed invasion is likely the greatest potential indirect threat to the species from the Proposed Action leading to increased competition, crowding, and alteration of habitat structure, ultimately causing the exclusion or extirpation of the orchid. Other potential indirect impacts include elevated dust levels, sedimentation in potential or occupied habitats, trampling by displaced wildlife and impacts to pollinators due to habitat fragmentation. However, applicant-committed measures to inventory and treat noxious weeds along all project-related disturbance areas and control dust (through gravelling roads or water) that could impact special status plants would greatly reduce this risk. Conservation measures specific to the application of herbicide near special status plants would minimize the risk of inadvertent impacts.

Ute Ladies'-tresses Determination (Proposed Action)

Implementation of the Proposed Action **may affect, but is not likely to adversely affect** the species.

Rationale for Ute Ladies'-tresses Determination (Proposed Action)

Ute ladies'-tresses are not known to occur in the project area, and only 11 acres of potential (riparian) habitat would be impacted under this alternative. Site-specific surveys and 100% avoidance of occupied habitat would occur under all alternatives. Based the analysis above, the limited potential of occurrence or loss of potential habitat or impacts to individuals, and applicant-committed conservation measures, the BLM has determined that the Proposed Action would not be likely to adversely affect the species.

4.12.1.1.1.8 Mexican Spotted Owl (MSO)

The primary direct effects of the Proposed Action on the Mexican Spotted Owl (MSO) result from disturbance and noise from construction activities during both foraging and nesting activities, and increased risk of mortality from vehicle collision. Indirect effects include loss of foraging habitat, loss of habitat suitable for its prey, and habitat fragmentation. The MSO nests and forages primarily in steep and narrow canyons in the northernmost portion of its range in south and central Utah. Direct effects on MSO habitat components are not expected as long as BLM stipulations pertaining to the MSO “fair,” “good,” or “excellent” rated habitat are followed. However, direct effects to foraging and nesting habitat may occur if construction takes place within or near canyons or forests that support good foraging and nesting habitat. Indirect effects on foraging habitat may occur if habitat and survival for MSO prey is impacted.

The MSO was detected in Jack Canyon in 2004 and in Water Canyon in the southeastern corner of the project area in 2007 (personal communication between J. H. Hornbeck, SWCA, and Bekee Megown, USFWS, 2007). Surveys for 2 years prior to project initiation will need to take place in designated critical habitat and habitat rated as “fair,” “good,” or “excellent” for MSO, which includes areas within the Green River, Water Canyon, Jack Canyon, Nine Mile Canyon, and others within that region.

Within the project area, 17,373 acres are considered suitable as MSO habitat and further classified as “good,” “fair,” or “poor” (USFWS 2004, SWCA 2005a). Approximately 17 acres, or 0.9%, of the 1,753 acres of MSO habitat classified as “good” in the project area, would be disturbed by construction of roads, well pads, and ancillary facilities such as pipelines and evaporative facilities (Table 4-105). None of the 480 acres of MSO habitat classified as “fair” in the project area would be disturbed; and approximately 108 acres, or 0.7%, of the 15,140 acres of MSO habitat classified as “poor” would be disturbed (see Table 4-105). As stated in Section 2.2.9, all “fair” and “good” habitat below the rim of Nine Mile Canyon will be avoided; however, all of the MSO habitat that would be disturbed under the Proposed Action occurs above the rim of Nine Mile Canyon. The Proposed Action would result in greater impacts to MSOs than the No Action Alternative due to the disturbance of 17 more acres of “good” habitat. Alternative A would result in impacts to 92 acres of 0.5-mile buffers surrounding MSO habitat in the project area, which is 87 more acres than the No Action Alternative (see Table 4-105).

Table 4-105. Surface Disturbance of Suitable MSO Habitat* in the Project Area Under Each Alternative

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Good Habitat						
Acres disturbed	17	4	62**	0	0	0
Percentage disturbed	0.9%	0.2%	3.5%	0.0%	0.0%	0.0%
Fair Habitat						
Acres disturbed	0	0	6**	10	0	0
Percentage disturbed	0%	0%	1.3%	2.1%	0.0%	0.0%
Poor Habitat						
Acres disturbed	108	92	431	16	41	80
Percentage disturbed	0.7%	0.6%	2.8%	0.1%	0.3%	0.5%
Half-mile Buffer Acreage						
Half-mile buffer acreage	92	25	260	5	8	42

*Includes all suitable habitats in the project area, as defined in Section 3.12.1.2.1.

** 52 acres of “good” and 5 acres of “fair” habitat located below the rim of Nine Mile Canyon would be avoided as stated in Applicant-committed Measures.

A reduction in habitat patch size due to an expanded road network would potentially reduce the distance of any MSO nests from a road and associated human disturbance. This, in turn, would increase the risk of reduced nesting frequency and/or success. An expanded road network and increased traffic volume within MSO habitat would also increase the likelihood of vehicle collisions. Finally, project-related activity and enhanced recreational access would increase the likelihood of wildfire from escaped campfires and electrical sparks within MSO habitat.

Applicant-committed conservation measures would minimize impacts to the MSO during the breeding season. Per BLM direction, 2 years of site-specific surveys will be completed prior to any construction-related disturbance in “fair” and “good” MSO habitat. If an owl responded to a call during a survey, consultation with USFWS would commence in order to ensure that appropriate conservation and avoidance measures are identified. Also, applicant-committed measures would result in a 0.5-mile nest buffer and timing constraints from March 1 to August 31. If site-specific surveys find good MSO habitat and active MSO nest and roost areas, measures would be taken to prevent impacts to those areas in order to avoid adverse effects.

Mexican Spotted Owl Determination (Proposed Action)

Implementation of the Proposed Action **may affect, but is not likely to adversely affect** the species.

Rationale for Mexican Spotted Owl Determination (Proposed Action)

Although 17 acres of "good" and 108 acres of "poor" MSO habitat would be affected by Alternative A, applicant-committed measures and conservation measures would eliminate direct impacts to individual birds and minimize direct impacts to suitable habitat to a negligible level. The impacts to habitat would constitute a small percentage of such habitats available throughout the range for this species.

4.12.1.1.1.9 Greater Sage-grouse

Activities under the Proposed Action could result in both direct and indirect, adverse impacts to the greater sage-grouse. Construction activities near active leks (or strutting grounds) during breeding season can have direct, adverse impacts to the greater sage-grouse. The use of vehicles and construction equipment, and disturbance of courtship activities can increase the risk of mortality of adult sage-grouse, eggs, nestlings, and fledglings. Sage-grouse do not readily accept new leks once existing leks are destroyed or disturbed (Rowland 2004). Human presence and noise associated with surface-disturbing activities or well production and maintenance activities could lead to lek abandonment by breeding males and females (hens). Because approximately 70% to 80% of all hens nest and raise their brood within 2.7 to 4.0 km (1.75–2.5 miles) of their breeding lek (Rowland 2004), surface-disturbing activities within a 2-mile radius could lead to nest abandonment. Based on the reaction of sage-grouse to gas development in areas similar to the project area (Rowland 2004; Utah Division of Wildlife Resources [UDWR] 2002a), such adverse impacts near leks and nesting sites would not be limited to construction activities, but would also include maintenance and general human disturbances.

These impacts would be unlikely to occur in the project area due to the following applicant-committed measures that would be adhered to under the Proposed Action.

- On BLM land, new construction and surface-disturbing activities would be avoided year-round within 0.25 mile of active greater sage-grouse strutting grounds, as well as strutting grounds previously identified by the BLM as being historically located in the area. No permanent facilities will be constructed within 2 miles of active strutting grounds when possible. No new construction or surface-disturbing activities would be conducted between March 1 and June 15 each year within greater sage-grouse nesting areas (a 2-mile radius of active strutting grounds in areas of sagebrush vegetation) until an activity survey is completed. If active nesting areas are documented by the AO during the annual survey, no new construction and surface-disturbing activities would take place within 0.5 mile of those nesting areas during the nesting period.
- Within 0.5 mile of known active leks, the best available technology will be used to reduce noise, e.g., installation of multi-cylinder pumps, hospital sound-reducing mufflers, and placement of exhaust systems.

One inactive greater sage-grouse lek has been identified in the project area; its 2-mile buffer encompasses 8,032 acres within the project area (UDWR 2006b). This lek has not been active for several years. In addition, UDWR has designated "brooding" and "wintering" habitats throughout Utah (including in the Uinta Basin) loosely surrounding leks. According to this designation, approximately 84,647 acres of suitable greater sage-grouse brooding and 38,747 acres of suitable greater sage-grouse wintering habitats exist in the project area (UDWR 2011b).

Under the Proposed Action, approximately 841 acres of surface disturbance would occur within the 2-mile buffer around the known greater sage-grouse lek (Table 4-106). This would comprise 10.5% of the 8,032 acres within the buffer zone. The removal of this land would constitute a direct, adverse impact because sage-grouse could no longer use this land for breeding, nesting, brood-rearing, or foraging. It would also constitute an adverse, indirect impact because these roads and facilities would measurably fragment the habitat of the greater sage-grouse. Approximately 3,048 acres of surface disturbance would occur within the 84,647 acres of UDWR-designated potential brooding habitat, constituting a conversion of 3.6% of total available acres within the project area. Additionally, approximately 2,267 acres of surface disturbance would occur within the 38,474 acres of UDWR-designated potential wintering habitat, constituting a conversion of 5.9% of the total available acres within the project area. As previously mentioned, this development would both directly and indirectly adversely impact the sage-grouse by directly removing and indirectly reducing the suitability and quality of brooding, wintering, and foraging habitat by fragmentation.

Table 4-106. Surface Disturbance of Greater Sage-grouse Lek Buffer and Brooding Habitat under Each Alternative

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
2-mile Buffer around Lek						
Acres disturbed	841	744	473	47	241	295
Percentage	10.5%	9.3%	5.9%	0.6%	3.0%	3.7%
Potential Brooding Habitat						
Acres disturbed	3,048	2,262	3,948	863	811	1,899
Percentage	3.6%	2.7%	4.7%	1.0%	1.0%	2.2%
Fragmentation of Potential Brooding Habitat						
Acres within 400m of roads	68,567	63,445	81,196	58,852	59,441	65,686
Percentage	81.0%	75.0%	95.9%	69.5%	70.2%	96.3%
Potential Wintering Habitat						
Acres disturbed	2,267	1,593	1,894	196	538	1,035
Percentage	5.9%	4.1%	4.9%	0.5%	1.4%	2.7%

Sage-grouse populations require large patches of continuous sagebrush habitats of a certain height, canopy cover, and density (BLM 2004a; Connelly et al. 2000). For this reason, the elimination, fragmentation, and degradation of habitat can lead to both small- and large-scale ecological effects. Potential effects of habitat fragmentation and habitat elimination would include the following: fewer suitable nest sites (thereby increasing competition), reduced forage, isolation of breeding habitat from brood-rearing areas, and isolation of leks from nesting habitat (BLM 2004a). The loss and degradation of sagebrush habitats would lead to lower nest initiation rates and nest site selection farther from lek sites (Lyon and Anderson 2003).

Greater sage-grouse habitat loss, degradation, and fragmentation are all likely to occur in the project area due to human activity (i.e., vehicle and pedestrian traffic, construction, etc.) and the noise associated with it. Roads can be particularly fragmentary to grouse habitat because, unlike gas wells and associated buildings, they involve moving vehicles, which occur infrequently, but can be potentially fatal. Project infrastructure could also lead to increased grouse predation by raptors perching on tanks or other facilities. However, applicant-committed BMPs for the site-specific use of centralized water and condensate tank facilities would reduce this effect where tanks are located farther from occupied habitat.

It is assumed that within a 1,300-foot (400-m) buffer around roads (following Connelly et al. 2000; Crawford et al. 2004; UDWR 2002a), the value of sage-grouse lekking and brooding habitat would be reduced. Sage-grouse would likely avoid these areas and would displace into adjacent habitats of higher value. The Proposed Action calls for new access roads to be built within 1,300 feet of 68,567 acres of designated brooding habitat in the project area (see Table 4-106). This would result in the devaluation or degradation of 81% of the 84,647 acres of suitable sage-grouse brooding habitat in the project area. However, approximately 69.5% of this habitat would be within 1,300 feet of a road under the No Action Alternative; therefore, the Proposed Action would represent an approximately 16.5% increase in habitat fragmentation over the No Action Alternative.

To reduce potential impacts to breeding sage-grouse, Gasco has committed to conducting presence/absence surveys within areas of suitable breeding habitat and, as applicable, would implement seasonal and spatial constraints as identified above. Overall, the Proposed Action would likely affect individual greater sage-grouse through habitat loss or degradation, and through a slightly increased risk in direct mortality.

The Proposed Action would result in more adverse impacts to the greater sage-grouse than under the No Action Alternative. Compared to the No Action Alternative, development under the Proposed Action would impact 794 more acres within lek buffers, result in the disturbance of 2,185 more acres of potential breeding habitat, and fragment 9,715 more acres of potential brooding habitat.

Greater Sage-grouse Determination (Proposed Action)

Implementation of the Proposed Action may impact and could lead to a downward population trend, but would not likely contribute to the listing of the species.

Rationale for Greater Sage-grouse Determination (Proposed Action)

Although 841 acres of within 2 miles of a known (inactive) lek and 3,048 acres of potential brooding habitat would be directly impacted by the Proposed Action, this constitutes a small percentage of such habitats available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat and eliminate direct impacts to individual birds during the nesting season.

4.12.1.1.1.10 Western Yellow-billed Cuckoo (WYBC)

The western yellow-billed cuckoo (WYBC) is an obligate riparian species that nests and forages in cottonwood-willow woodlands with a dense sub-canopy. There is a low potential for the species to occur within the project area because the WYBC is known to require 100 to 200 acres of contiguous riparian nesting habitat for breeding. There are four patches of native riparian habitat of suitable size for breeding habitat in the project area: three of the patches are in the northeastern corner of the project area, while a fourth potential habitat area is in the Green River corridor. Alteration of the hydrology and plant community structure of riparian habitats has substantially reduced the extent and quality of breeding areas and the species' range.

Direct impacts to the WYBC include increased risk of direct mortality and habitat loss. Indirect effects include noise impacts to nesting birds, and increased invasion of non-native plants into suitable habitat. Invasion of riparian habitats by aggressive non-native species, particularly tamarisk (*Tamarix* spp.), adversely impact the WYBC. Other potential indirect impacts to the species include decreased water quality, and degradation of riparian vegetation due to erosion and sedimentation associated with surface disturbance.

Under the Proposed Action, 29 acres (2.4%) of riparian habitats would be disturbed (Table 4-107), however, these disturbances would be concentrated in 2 of the 4 suitably large tracts of riparian habitat present in the project area. These habitat areas are located within the 100-year floodplain of the Green River in the extreme northeastern corner of the project area. Under existing regulations, guidelines, and applicant-committed measures, well pads and associated roads and pipelines would be located to avoid or minimize impacts in riparian areas and the 100-year floodplain of the Green River, and appropriate erosion control and revegetation measures would be employed (see Section 2.1, Table 2-1). Nevertheless, well-pad development and associated disturbances proposed under this alternative would likely fragment these riparian habitat occurrences into smaller patches no longer suitable for the WYBC.

Table 4-107. Surface Disturbance of WYBC Riparian Habitat in the Project Area under Each Alternative

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Acres disturbed	29	19	9	8	6	0
Percentage disturbed	2.4%	1.6%	0.7%	0.7%	0.5%	0.0%

Adverse impacts to the species would be mitigated by restricting new surface-disturbing activities within 330 feet of riparian areas. In wet meadows, springs, and seeps, surveys to assess riparian habitat on a case-by-case basis would take place prior to the initiation of any construction activities. If the species or habitat for the WYBC is found, then the area would be avoided if possible.

Western Yellow-billed Cuckoo Determination (Proposed Action)

Implementation of the Proposed Action may impact and could lead to a downward population trend, but **would not likely contribute to the listing of the species.**

Rationale for Western Yellow-billed Cuckoo Determination (Proposed Action)

Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat and eliminate direct impacts to individual birds. Although 29 acres of suitable WYBC habitat would be directly impacted by the Proposed Action, this constitutes a negligible percentage of suitable habitat available throughout the extensive range of this species.

4.12.1.1.1.11 Threatened, Endangered, and Candidate Fish Species

Direct impacts to Colorado River endangered fish (bonytail chub, Colorado pikeminnow, humpback chub, and razorback sucker) under the Proposed Action would include an increased risk of accidental spills of pollutants such as natural-gas condensate and oil into the Green River or its tributaries, and flow depletion due to consumptive water use. Indirect impacts would include increased sedimentation of the Green River.

The risk of spills and contamination would be increased by 2 aspects of the Proposed Action. First, approximately 743 pipeline crossings of intermittent/ephemeral drainages that are tributary to the Green River would be required under the Proposed Action (Table 4-108). Second, 11 wells are proposed within the 100-year floodplain for the Green River. Associated with these wells are 1.3 miles of roads and pipelines in the Green River floodplain (see Table 4-108). These wells all lie directly within designated critical habitat for the Colorado pikeminnow and the razorback sucker.

An additional 36 wells are proposed within 100-year floodplains of Green River tributaries within 5 miles of the river, along with 7 miles of new roads and 13 miles of pipeline. The 11 wells within the Green River floodplain would be located 9 miles upstream of critical habitat for the bonytail chub and the humpback chub, and would therefore not constitute a risk of acute toxicity within critical habitat areas.

Table 4-108. Potential Impacts to Green River Fishes and Development within or near the Green River Floodplain

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Acre-feet of Green River Basin consumptive water use (LOP)	288	215	365	71	215	251
Acres of water-erosive soils disturbed	30	28	37	10	1.4	21
Number of intermittent/ephemeral stream pipeline crossings	743	600	1,253	473	347	744
Number of wells in the Green River floodplain	11	8	4	4	7 wells/ 2 pads	0
Miles of road/pipeline in Green River floodplain	1.3	1.5	0.8	0.6	0.6	0
Number of wells in 100-year floodplain within 5 miles of the Green River*	36	23	34	6	31 wells/ 8 pads	0
Miles or pipeline in 100-year floodplain within 5 miles of the Green River*	13.0	11.1	24.7	7.5	10.9	0

*Does not include wells or pipeline in the Green River Floodplain (which are included 2 rows above).

The physical and behavioral effects on fish of exposure to polynuclear aromatic hydrocarbons (PAHs; chemicals associated with fossil fuels development) have been documented in many species. Potential physical effects include external lesions (Myers et al. 1994), abnormal embryo development (Incardona et al. 2005), and mortality due to liver and kidney toxicity (Reimschuessel 1993). Potential behavioral effects include reduced feeding and reduced activity (Little et al. 1993). The San Juan River in the four corners area of Utah, Colorado, Arizona, and New Mexico is similar to the Uinta Basin in that it is of high interest for fossil fuels production and several of the same species of endangered fishes inhabit the watershed. After an analysis of fish bile from fish caught throughout the San Juan watershed, it was determined that there was aquatic exposure to PAHs at levels that indicated a concentrated source of those chemicals (Wilson et al. 1995). Consequences to fish health and trends could not be determined from that study.

Water and soil testing near concentrated areas of oil and gas development were conducted in the BLM's Farmington District of New Mexico to asses whether PAHs were reaching the nearby San Juan River and its tributaries in doses harmful to endangered fishes (Odell 1997). None of the 51 water samples contained detectable levels of PAH (Odell 1997). In association with the same study, LC50 levels (the concentration at which mortality occurs in 50% of the sample population in a given time period) of four PAHs on juveniles of three fish species (Colorado pikeminnow, razorback sucker, and fathead minnow) were tested over the course of six days (National Biological Service 1995). The effects of experimental doses of PAHs with and without exposure to simulated solar UV were also documented. This is because some PAHs begin harmful chemical chain reactions only after exposure to sunlight (photo-activation). Mortality only occurred with exposure to solar UV in addition to PAH exposure. Colorado pikeminnow was the most sensitive to PAH exposure coupled with solar UV, with LC50 levels ranging from 4–7 microgram per liter (ug/L). Fathead minnow was the least sensitive to PAH exposure coupled with solar UV, with LC50 levels ranging from 6–15 ug/L. Furthermore, fry were more sensitive than juvenile fish. Similar tests conducted on fish larvae found LC50 levels to be approximately 10 times lower than those for juvenile fish (0.38 ug/L–4.4 ug/L) with mortality occurring within three to four days.

The risk of acute or chronic toxicity to endangered fish in the Green River in the event of a natural-gas condensate spill would depend on the location of the spill relative to the main stem Green River. Natural gas condensate contains a variety of lightweight hydrocarbons, of which the most toxic to aquatic biota is the aromatic hydrocarbon fraction (benzene, ethylbenzene, toluene, xylenes). These account for less than 0.5% of the volume of condensate (BLM 2005b). Natural-gas condensate is highly volatile and likely to evaporate within approximately 8 hours of spilling (BLM 2005b). Thus, spills occurring in close proximity to the Green River, or in streams with flow rates that would deliver condensate to the Green River prior to evaporation, would pose a risk of exposing Colorado River fish to potentially lethal levels of toxic substances. Under the Proposed Action, pipelines would cross ephemeral streams at 743 locations within the project area (see Table 4-108). Because the crude oil extracted within the project area is solid within the temperature range of the area's climate, oil would not pose a risk of acute toxicity for Colorado River endangered fish in the event of an accidental spill. A catastrophic spill of a 400 -barrel (16,800 gallon) condensate tank within the 100-year floodplain of the Green River, while unlikely, would have a high probability of producing acutely toxic concentrations of condensate in the Green River, and is therefore considered a possible adverse impact to Colorado River fish. A spill from a condensate tank within the Green River floodplain would constitute the overall worst case scenario under the Proposed Action, and would likely result in acute toxicity at some flow levels and an adverse impact to designated critical habitat.

However, applicant-committed BMPs for the site-specific use of buried pipelines and centralized water and condensate tank facilities where they were determined to be appropriate at the site-specific level would reduce the risk of spills from pipelines and tanks. Burying pipelines would reduce the risk of accidental puncture of pipelines, and central tanks batteries could be located outside the floodplain, greatly reducing the risk of spills affecting the Green River. Because proposed mitigation measures (see Section 4.12.2.6) would preclude the development of wells in the floodplain, the risk of a spill from pipelines is considered separately below.

The BLM analyzed the risk of toxicity to endangered fish from potential spills into Pariette Draw and its tributaries in the Final EIS and Record of Decision (ROD) for the Castle Peak and Eightmile Flat Oil and Gas Expansion Project (BLM 2005b). Because that study used conservative assumptions that would also provide a conservative spill risk assessment of the Proposed Action, some of the study's conclusions are applicable to this analysis. For the purposes of this analysis, that study's worse case scenarios of spills directly into the Green River (via Sheep Wash) and into Lower Pariette Draw (which is historical habitat for the flannelmouth sucker and a direct tributary to the Green River) are applied and would also constitute the worst case scenarios for spills from pipelines under the Proposed Action.

Assuming full draindown of 1.5 miles of unpigged 3-inch transmission pipeline, approximately 2,660 gallons of condensate would be released in the event of a spill. Further assuming that 1% of this total was composed of the toxic aromatic hydrocarbon competent of condensate and there was no attenuation of the spill (i.e., 100% reached the river in a single slug), the Final EIS and ROD for the Castle Peak and Eightmile Flat Oil and Gas Expansion Project (BLM 2005b) concluded that a spill directly into the Green River or a tributary to the Green River would not result in acutely toxic concentrations in the Green River, even under very low flow conditions. With the Green River flowing at only 828 cubic feet per second (cfs), such a spill will would result in a concentration of approximately 0.7 ppm (parts per million), or approximately 10% of the toxic threshold of 7.4 ppm. Using that document's analysis, it can be conservatively assumed that a spill of 2,660 gallons or more would reach toxic concentrations only when flows in the Green River (or a smaller stream) are at or below approximately 79 cfs. This is well below the lowest recoded streamflow in the Green River. Therefore, only Pariette Draw, Nine Mile Creek, and other small tributaries to the Green River that are not designated habitat of the Colorado River endangered fish would be at risk of toxic concentrations following an accidental release.

Sub-lethal impacts are not expected because of the low risk of a spill and the short residence time of condensate once spilled (due to evaporation and dilution). Chronic effects are not expected because spills would result in a short residence time in any single location due to rapid evaporation, dilution, and downstream transport. Constituents that may persist for more than a day are relatively insoluble and have low toxicity to aquatic species (BLM 2005b). Because evaporation and dilution would reduce the potential contamination to shorter timeframes than are required for chronic toxicity (i.e., weeks to months), it is reasonable to assume chronic toxicity would not be an issue (BLM 2005b).

Due to the conservative assumptions used in these calculations, and applicant-committed measures including the use of shutoff valves (where applicable to protect streams at pipeline crossing from contamination and reduce accidental discharge) and the burial of pipelines at least 3 feet below all crossings and in conformance with hydrological design practices, the risk of a pipeline spill reaching toxic concentrations in areas used by Colorado River endangered fish would be very low under the Proposed Action.

The likelihood of a spill under the Proposed Action is independent of an accidental spill's toxicity, which is described above. Applying the historical national average for pipeline accidents of 0.001 incidents/mile/year (BLM 2005b), the 1.3 miles of pipeline in the Green River floodplain under the Proposed Action would carry a risk of 0.039 incidents over the 30-year production phase (over which each pipeline would be used), or one incident every 764 years. The 13 miles of pipeline crossing floodplains within 5 miles of the Green River would carry a risk of 0.39 incidents over the 30-year production phase over which each pipeline would be used, or one incident every 77 years. Attenuation of spills upstream of the Green River floodplain would be considerable however, and in 80% of pipeline spills, less than 8.5% of the pipe's volume is actually released (BLM 2005b). Therefore, spills large enough to reach the Green River would have a risk of occurring far less frequently than every 77 years. The likelihood of spills in individual tributary drainages to the Green River is discussed in Section 4.15.1.1.2.2.

Development of oil and gas wells requires water for both well drilling and completion. Approximately 3.09 acre-feet of treated and recycled water and 0.19 acre-feet of fresh water would be consumed during drilling and completion of each well. Assuming a drilling rate of approximately 120 wells per year, peak annual withdrawals of approximately 23 acre-feet of water would be drawn from sources that feed the Green River (see Table 4-108). This equates to approximately 0.04 cfs of withdrawal (assuming that water use occurs evenly over 240 days per year), or 288 acre-feet over the lifetime of the project (see Table 4-108). A 0.04 cfs withdrawal would represent a loss of approximately 0.005% of the approximately 1,000 cfs recorded minimum stream flow of the Green River adjacent to the project area (based on stream flow records since 1992 for the Green River (as measured at Jensen, Utah) and the White River (as measured at Watson, Utah). This flow reduction would be considered a long-term (life of the project) impact in terms of reductions in habitat for listed fish species in the Green River.

One of the main factors in the listing of the Colorado River fishes was the cumulative effect of water depletion within the Colorado River system, which includes the Green and Duchesne rivers and their associated critical habitat. New depletions from these rivers or changes in the amount of water returned to the rivers would constitute an additional impact on the Colorado River fishes. To ensure the survival and recovery of the listed species, water users currently are required to make a one-time payment to the USFWS Recovery Program. The expected depletion fee would be paid by the project proponent prior to initiation of the project.

Based on soil erosion and sediment yield analyses (see Sections 4.15, Water Resources, and 4.10, Soils), project-related disturbance would increase the Green River's sediment load by approximately 107,919 tons/year, or 0.03% (see Table 4-131 in Section 4.15). However, in some areas soils are high in selenium, boron, and other potentially toxic components. The effects of sediment derived from such soils on Colorado River endangered fish are poorly understood, but are generally thought to be harmful at unknown concentrations. Thus, increases in sediments containing boron or selenium could affect all of the special status fishes. However, soils containing these constituents are naturally occurring and natural contributors of sediment to the Green River. Because the Proposed Action would lead to an approximately 0.03% increase to the Green River's total sediment load, it is unlikely that this increase in sediments containing these constituents would adversely affect Green River fish. Approximately 30 acres of highly erosive soils would be disturbed under the Proposed Action (see Table 4-108).

The segment of the Green River that borders the eastern boundary of the project area has been designated as critical habitat for the Colorado pikeminnow and the razorback sucker. One of the primary constituent elements used to model critical habitat for these fish is “physical habitat” (50 Code of Federal Regulations [CFR] 13374). Physical habitat includes areas that are “…inhabited or potentially habitable by fish for use in spawning, nursery, feeding, and rearing, or corridors between these areas” (50 CFR 13374). Designation of critical habitat for the razorback sucker placed a special importance on known or suspected spawning habitat. Therefore, it is assumed that the stretch of the Green River on the eastern border of the project area is or is suspected to be important spawning habitat for these 2 species. Potential impacts of the Proposed Action on fish spawning habitat include the loss of important elements of spawning habitat through mixing stream bottom substrates or changing local water levels or flow patterns and the increased potential for fish larvae or egg mortality due to hydrocarbon exposure.

The Proposed Action would result in greater potential impacts to Colorado River fish than would occur under the No Action Alternative. Compared to the No Action Alternative, development under the Proposed Action would consume 217 more acre-feet of water from the Green River Basin, result in the disturbance of 20 more acres of highly erosive soils, and require 270 more intermittent/ephemeral stream crossings by pipelines. The Proposed Action would also result in seven more wells (and 0.7 more mile of pipeline) in the Green River floodplain, and 30 more wells (and 5.5 more miles of pipeline) crossing floodplains within 5 miles of the Green River.

Colorado River Endangered Fish Determinations (Proposed Action)

The Proposed Action **may affect, and is likely to adversely affect** all Colorado River endangered fish.

Colorado River Endangered Fish Determination Rational (Proposed Action)

1) Green River Depletions:

   Because of the cumulative impacts of incrementally small water depletions in the Colorado River basin, the USFWS views any depletion as likely to adversely impact all of the Colorado River endangered fish considered.

2) Risk of spills from wells and pipelines in the Green River floodplain:

   a) The Proposed Action may affect fish due to increased risk of condensate spill from wells within Green River floodplain, and is likely to adversely affect fish because of the risk of a spill exceeding toxic concentrations in the Green River. However, applicant-committed BMPs for the site-specific use of centralized condensate tank facilities would reduce the spill risk from tanks grouped outside of the floodplain.

   b) The Proposed Action may affect fish due to increased risk of condensate spill from pipelines within Green River floodplain or tributaries, but is unlikely to adversely affect fish because applicant BMPs including shutoff valves and pipe burial would mitigate the risk of a spill exceeding toxic concentrations in the Green River.

3) Impacts to critical habitat:

   The Proposed Action would adversely affect critical habitat of the Colorado pikeminnow and the razorback sucker, due to wells and associated roads and pipelines proposed within the 100-year floodplain for the Green River. These wells would lie within designated critical habitat for the Colorado pikeminnow and the razorback sucker. The Proposed Action would also increase the risk of adversely affecting critical habitat because of the increased risk that a spill from a condensate tank would exceed toxic concentrations in the Green River. If mitigation measures were applied (see Section 4.12.2.6) to prevent wells from being located in the floodplain, these impacts would be negated or reduced to a minimal risk.

4) Sedimentation:

   The Proposed Action may affect Colorado River fish, due to slight increase in sedimentation and sediments containing selenium and boron, but is unlikely to adversely affect these fish because of the minimal increase in the sediment load of the Green River.

4.12.1.1.2 State of Utah and BLM Sensitive Species

4.12.1.1.2.1 Untermann Daisy

The development of wells, roads, and associated facilities under the Proposed Action would disturb 1,701 acres of potential Untermann daisy habitat, or 3.7% of its potential habitat in the project area. Approximately 12,438 acres of potential Untermann daisy habitat would be effectively located within 300 feet of existing and proposed roads under this alternative, and therefore at greater risk of indirect adverse impacts such as the invasion of non-native species.

Table 4-109 provides a comparison of the number of acres of potential Untermann daisy habitat impacted by each alternative, and acres of potential Untermann daisy habitat located within 300 feet of roads.

Table 4-109. Surface Disturbance of Potential Untermann Daisy Habitat* in the Project Area under Each Alternative

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Acres disturbed	1,701	1,608	2,174	281	597	1,152
Percentage disturbed	3.7%	3.5%	4.7%	0.6%	1.3%	2.5%
Habitat acreage within 300 feet of roads	12,437.7	12,225.1	14,566.1	7,552.2	9,028.7	11,436

*Includes all potential habitat in the project area, as defined in Section 3.12.2.1.1.

Direct adverse effects of the Proposed Action would result from surface disturbance described above that would be associated with the construction of well pads, roads, and ancillary facilities within the 46,049 acres of potentially occupied by Untermann daisy, or necessary for its recovery within the project area. Surface disturbance would result in an overall reduction in habitat and an increase in habitat fragmentation. Reduction of existing or potential habitat would be a long-term impact, with the potential to persist well beyond the project's duration due to the poor reclamation potential of project area soils (see Section 4.10, Soils) and the high potential for invasion by noxious weeds (see Section 4.13, Vegetation).

For the purposes of this analysis, this habitat would be more susceptible to the indirect effects of construction of roads. Potential Untermann daisy habitat disturbed or adjacent to disturbed areas would also be susceptible to invasion by weeds such as cheatgrass following surface disturbance. Weed invasion would have adverse impacts on Untermann daisy due to increased competition for nutrients, water, and light, and weed-induced alteration of habitat structure and composition, and would be more likely on the 12,437.7 acres within 300 feet of new roads under the Proposed Action. These effects would reduce the suitability of the habitat, and could ultimately lead to population declines due to the exclusion of the species. However, applicant-committed measures to inventory and treat noxious weeds along all project-related disturbance areas would greatly reduce this risk. Additional indirect impacts to Untermann daisy would include an increased risk of crushing by OHVs due to an expanded road network in the project area, impacts from herbicides used to control invasive plants in the project area, and possible reductions in pollination or seed dispersal due to a larger road network and resulting habitat fragmentation. Conservation measures specific to the application of herbicide near special status plants would essentially minimize the risk of inadvertent herbicide impacts.

Untermann Daisy Determination (Proposed Action)

Implementation of the Proposed Action may affect individuals, but is **not likely to contribute to the need to become listed**.

Rationale for Untermann Daisy Determination (Proposed Action)

Because direct impacts to the Untermann daisy's habitat would total fewer than 4% of the potential habitat available in the project area, and because considerable additional habitat exists beyond the project area, project-related activities are not likely to contribute to the need for federal listing of the species.

4.12.1.1.2.2 Sterile Yucca

Development under the Proposed Action would disturb 0.21 acres of known sterile yucca habitat, or 2.5% of its known habitat in the project area. Approximately 5.7 acres of known sterile yucca habitat would be effectively located within 150 feet of existing and proposed roads under this alternative, and therefore at greater risk of indirect adverse impacts such as the invasion of non-native species. Table 4-110 provides a comparison of the number of acres of known sterile yucca habitat impacted by each alternative, and acres of known sterile yucca habitat located within 150 feet of roads.

Table 4-110. Surface Disturbance of Known Sterile Yucca Habitat* in the Project Area under Each Alternative

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Acres disturbed	0.21	0.15	0.15	3.06	0.15	0.29
Percentage disturbed	2.5%	1.8%	1.8%	36.4%	1.8%	3.5%
Habitat acreage within 150 feet of roads	5.7	4.6	4.6	4.6	4.6	5.7

*Includes all known habitat in the project area, as defined in Section 3.12.2.1.1.

Direct adverse effects of the Proposed Action would result from surface disturbance described above that would be associated with the construction of well pads, roads, and ancillary facilities within the 8.4 acres of known habitat occupied by sterile yucca. Surface disturbance would result in an overall reduction in habitat and an increase in habitat fragmentation. Reduction of existing or known habitat would be a long-term impact, with the potential to persist well beyond the project's duration due to the poor reclamation potential of project area soils (see Section 4.10, Soils) and the high potential for invasion by noxious weeds (see Section 4.13, Vegetation).

Known sterile yucca habitat, especially acreage within 150 feet of roads, would be more susceptible to the indirect effects of road construction, such as invasion by weeds. Weed invasion would have adverse impacts on sterile yucca due to increased competition for nutrients, water, and light, and weed-induced alteration of habitat structure and composition. These effects would reduce the suitability of the habitat, and could ultimately lead to population declines due to the exclusion of the species. However, applicant-committed measures to inventory and treat noxious weeds along all project-related disturbance areas would greatly reduce this risk. Other indirect effects to sterile yucca would include an increased risk of crushing by OHVs due to an expanded road network in the project area, impacts from herbicide use for the control of invasive plants in the project area, and possible reduction in pollination or seed dispersal due to a larger road network and resulting habitat fragmentation. Conservation measures specific to the application of herbicide near special status plants would essentially minimize the risk of inadvertent herbicide impacts. Other avoidance and minimization measures would be addressed at the site-specific level. Site-specific surveys and a 150-foot avoidance buffer would be required if deemed necessary by the AO during project implementation.

Sterile Yucca Determination (Proposed Action)

Implementation of the Proposed Action may affect individuals, but is **not likely to contribute to the need to become listed**.

Rationale for Sterile Yucca Determination (Proposed Action)

Because direct impacts to the sterile yucca's habitat would total less than than 3% of the known habitat available in the project area, and because considerable additional habitat exists beyond the project area, project-related activities are not likely to contribute to the need for federal listing of the species. In addition, site-specific avoidance and minimization measures, where required by the AO, would further reduce direct or indirect impacts to sterile yucca individuals and habitats.

4.12.1.1.2.3 Graham's Catseye, Barneby's Catseye, Goodrich's Blazingstar, Goodrich's Columbine, and Uinta Greenthread

Graham's catseye has been observed in the project area (see Map 37). Barneby's catseye, Goodrich's blazingstar, Goodrich's columbine, and Uinta greenthread have not been documented in the project area, but have the potential to occur based on project area vegetation communities and elevation ranges. Acreages of the potential or suitable habitats have not been mapped or determined for any of these five species. In general, direct and indirect impacts to these five BLM sensitive plant species from the Proposed Action and alternatives would be similar to impacts already described for other State of Utah and BLM sensitive plant species. Direct impacts would include surface disturbance resulting in habitat reduction and fragmentation, and increased risk of crushing due to an expanded road network. Indirect impacts include invasion of non-native species, impacts from herbicide use, and possible reduction in pollination or seed dispersal. Indirect impacts would be greater due to 3.6 times (243) more miles of roads that would occur under the No Action Alternative. Applicant-committed measures and conservation measures would minimize impacts from non-native species and herbicides. Other avoidance and minimization measures would be addressed at the site-specific level. Site-specific surveys and a 150-foot avoidance buffer would be required if deemed necessary by the agency official during project implementation.

Graham's catseye, Barneby's catseye, Goodrich's blazingstar, Goodrich's columbine, and Uinta greenthread Determination (Proposed Action)

Implementation of the Proposed Action may affect individuals, but is **not likely to contribute to the need for listing for any of the five species**.

Rationale for Graham's catseye, Barneby's catseye, Goodrich's blazingstar, Goodrich's columbine, and Uinta greenthread Determination (Proposed Action)

Because additional habitats for Graham's catseye, Barneby's catseye, Goodrich's blazingstar, Goodrich's columbine, and Uinta greenthread exist beyond the project area, and because site-specific avoidance and minimization measures, where required by the AO, would further reduce direct or indirect impacts to individuals and habitats, project-related activities are not likely to contribute to the need for federal listing of these species.

4.12.1.1.2.4 White-tailed Prairie Dog

Development under the Proposed Action would have adverse impacts on white-tailed prairie dogs in the project area. The potential impacts would include a direct loss of habitat; an increased risk of direct mortality from shooting and vehicle strikes; and the decreased availability of certain habitats through habitat fragmentation, and habitat modification, and displacement (due to increased noise and human presence). Habitat loss would be considered a long-term direct adverse impact because prairie dogs would be unable to access or use the land throughout the life of the project. The discontinuous nature of the habitat loss would also contribute to habitat fragmentation—an indirect long-term adverse impact.

Approximately 15,661 acres of white-tailed prairie dog habitat have been identified within the northeast portion of the project area. Surface-disturbing activities associated with the Proposed Action (e.g., the construction of well pads, pipelines, and access roads) would result in the loss of approximately 481 discontinuous acres of prairie dog habitat in the project area, or 3.1% of the habitat identified within the project area. Table 4-111 provides a comparison of the number of white-tailed prairie dog habitat acres directly impacted by each alternative. However, applicant-committed interim and post-construction reclamation and restoration measures would also help to minimize adverse impacts to this species.

Table 4-111. Surface Disturbance of Prairie Dog Habitat in the Project Area under Each Alternative

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Acres Disturbed	481	224	982	337	176	147
Percentage Disturbed	3.1%	1.4%	6.3%	2.2%	1.1%	0.9%

In addition to habitat loss, the Proposed Action would increase the risk of direct mortality of white-tailed prairie dogs. Expanded roadway systems would increase long-term traffic and visitation in the project area, potentially leading to increased vehicle-related fatalities and recreational prairie dog shooting. Project infrastructure could also lead to increased predation by raptors perching on tanks or other facilities. However, applicant-committed BMPs for the site-specific use of centralized water and condensate tank facilities would reduce this effect where tanks were located further from occupied habitat.

Prairie dogs have been known to tolerate human presence and adapt to disturbed sites. Once short-term construction activities are complete, prairie dogs in the project area may potentially adapt to the long-term presence of established wells and roads, and make use of nearby areas that have adequate low or regenerating vegetation cover for new colony locations.

White-tailed Prairie Dog Determination (Proposed Action)

Implementation of the Proposed Action may affect individuals, but is **not likely to contribute to the need to become listed.**

Rationale for White-tailed Prairie Dog Determination (Proposed Action)

Based on this analysis, the Proposed Action would result in direct adverse impacts to fewer than 500 acres (or approximately 3%) of the white-tailed prairie dog habitat available in the project area. White-tailed prairie dogs are found across the western half of Wyoming, western Colorado, the eastern portion of Utah, and a small portion of southern Montana. The largest remaining complexes or groups, occupying more than 5,000 acres each, are primarily found in Wyoming. Because of this relatively small level of impact to a species with large habitat areas beyond the project area, the BLM has determined that the Proposed Action would not contribute to the need for federal listing of white-tailed prairie dogs.

4.12.1.1.2.5 Big Free-tailed Bat

Approximately 3,969 acres of potential big free-tailed bat roosting and 129,279 acres of potential foraging habitat have been identified in the project area. Table 4-112 provides a comparison of the number acres of potential big free-tailed bat roosting and foraging habitat directly impacted by each alternative.

Table 4-112. Surface Disturbance of Big Free-tailed Bat Potential Habitat in the Project Area Under Each Alternative

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Roosting Habitat						
Acres disturbed	156	119	163	31	46	107
Percentage disturbed	3.9%	3.0%	4.1%	0.8%	1.2%	2.7%
Foraging Habitat						
Acres disturbed	5,445	3,958	6,794	1,541	1,535	2,366
Percentage disturbed	4.2%	3.1%	5.3%	1.2%	1.2%	1.8%

Development of the Proposed Action could have adverse impacts on big free-tailed bats in the project area. The potential adverse impacts would include a direct loss of both roosting and foraging habitat; the decreased availability of certain habitats through displacement (due to increased noise, human presence, and surface-disturbing activities), habitat fragmentation, and habitat modification. Direct effects would also include decreased productivity due to loss of roosting habitat and displacement.

Indirect effects include light pollution from night-time flood lighting. Light pollution has shown to disrupt the natural roost emergence timing, predator avoidance strategies, and foraging patterns of bats (Navara and Nelson 2007; Briggs 2004).

Section 4.16.1.1.6 describes both direct and indirect effects of the proposed evaporative facilities on all bat species, including the big free-tailed bat. Impacts include potential long-term health effects due to the ingestion of high doses of salt, surfactant, and other chemicals with the potential to be found in the evaporation pond and through the bioaccumulation of these chemicals from certain aquatic insect species able to emerge from hypersaline water. As noted in Section 4.16.1.1.6, deterrent systems typically used at evaporation ponds designed to deter bird species are often ineffective for bats.

Big Free-tailed Bat Determination (Proposed Action)

Implementation of the Proposed Action may affect individuals, but is **not likely to contribute to the need to become listed**.

Rationale for Big Free-tailed Bat Determination (Proposed Action)

Although the Proposed Action could potentially result in direct and indirect adverse impacts to big free-tailed bats, the probability of impact to the species as a whole is very low based on the percentage of potential roosting and foraging habitats of this wide-ranging bat that would be disturbed during the life of the project. The big free-tailed bat ranges throughout the southwest United States, as well as into Central and South America. Based on this analysis, the BLM has determined that the Proposed Action would not likely result in the need for federal listing.

4.12.1.1.2.6 Spotted Bat

Approximately 3,969 acres of potential spotted bat roosting and 192,832 acres of potential foraging habitat have been identified in the project area. Table 4-113 provides a comparison of the number acres of spotted bat potential roosting and foraging habitat directly impacted by each alternative.

Table 4-113. Surface Disturbance of Spotted Bat Potential Habitat in the Project Area under Each Alternative

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Roosting Habitat						
Acres disturbed	156	119	163	31	46	107
Percentage disturbed	3.9%	3.0%	4.1%	0.8%	1.2%	2.7%
Foraging Habitat						
Acres disturbed	7,066	5,302	9,383	1,933	1,792	3,468
Percentage disturbed	3.7%	2.7%	4.9%	1.0%	0.9%	1.8%

Both direct and indirect impacts to spotted bats would be of the same nature as those described above for the big free-tailed bat, and would affect approximately the same acreage of potential habitat.

Spotted Bat Determination (Proposed Action)

Implementation of the Proposed Action may affect individuals, but is **not likely to contribute to the need to become listed**.

Rationale for Spotted Bat Determination (Proposed Action)

While the Proposed Action could potentially result in direct and indirect adverse impacts to spotted bats, the probability is relatively low based on the percentage of potential roosting and foraging habitats of these wide-ranging bats that would be disturbed during the life of the project. Based on this analysis and applicant-committed mitigation measures, the BLM has determined that the Proposed Action would not likely result in the need for federal listing.

4.12.1.1.2.7 Burrowing Owl

Development of the Proposed Action would have both direct and indirect adverse impacts on burrowing owls in the project area. The adverse impacts would include a direct loss of nesting and foraging habitat; an increased risk of vehicle-related mortality; increased displacement due to increased noise and human presence; increased habitat fragmentation and habitat modification; and an increase of non-native plants.

Under the Proposed Action, 107 acres (7.0%) of surface disturbance would occur within 0.5 mile of a known burrowing owl nest. Table 4-114 provides a comparison of the number acres located within 0.5 mile of a known burrowing owl nest that would be directly impacted by each alternative.

Table 4-114. Surface Disturbance within 0.5 Mile of Burrowing Owl Nests under Each Alternative

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Acres disturbed	107	0	63	14	2	8
Percentage disturbed	7.0%	0.0%	4.1%	0.9%	0.1%	0.5%

Because burrowing owl nesting sites are so closely correlated with prairie dog towns, any direct habitat loss in existing or potential prairie dog habitats would negatively affect nesting burrowing owls in the project area. Individual burrowing owls have moderate to high site fidelity to general breeding areas, prairie dog colonies, and even to particular nest burrows (Klute et al. 2003). Burrow and nest sites are reused at a higher rate if the bird has reproduced successfully during the previous year (Haug et al. 1993). Surface disturbing activities associated with the Proposed Action (e.g., the construction of well pads, pipelines, and access roads) would result in the loss of approximately 481 acres of prairie dog/burrowing owl nesting habitat in the project area (Table 4-111). The Proposed Action would result in greater impacts to the burrowing owl than would occur under the No Action Alternative. Compared to the No Action Alternative, development under the Proposed Action would result in the disturbance of 93 more acres of the burrowing owl's nesting and foraging habitat.

Habitat loss is considered a long-term direct adverse impact because burrowing owls would be unable to access or use the land throughout the life of the project. The discontinuous nature of the habitat loss would also contribute to habitat fragmentation—a long-term indirect adverse impact. In addition to habitat losses, the Proposed Action would increase the risk of direct mortality of burrowing owls if mitigation was not implemented. Expanded roadway systems would increase traffic and human visitation in the project area over the long-term, potentially leading to increased vehicle strikes. Burrowing owls are often observed hunting and flying along roads.

Implementation of the Proposed Action could also alter potential burrowing owl habitat, making it less suitable for the establishment of future nests. As traffic volumes and project-related activities increase with increased construction, adjacent habitats may be avoided due to human presence, noise, and the potential influx of invasive weeds. Habitat quality can be reduced by the introduction of invasive weeds, which may reduce the amount of native perennials and bare ground in an area, decreasing forage quality and visibility from burrow entrances.

Burrowing owls are known to tolerate human presence and adapt to disturbed sites to some degree (Dechant et al. 1999). Once short-term construction activities are complete, burrowing owls in the project area would likely adapt to the long-term presence of established wells and roads, following prairie dogs into nearby areas of scraped, bare ground.

Applicant-committed measures and BMPs would minimize adverse impacts to burrowing owls, especially during the breeding season. Vernal RMP BMPs requires a 0.5-mile construction buffer around active raptor nest sites during the breeding season (see Section 2.2.9 and Table 2-1 for applicant-committed measures and BMPs pertaining to burrowing owls). This measure reduces the risk of direct mortality during the breeding season.

Burrowing Owl Determination (Proposed Action)

Implementation of the Proposed Action may affect individuals, but is **not likely to contribute to the need to become listed.**

Rationale for Burrowing Owl Determination (Proposed Action)

Although 481 acres of burrowing owl habitat would be directly impacted by the Proposed Action, this constitutes a small percentage of suitable habitat available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat and eliminate direct impacts to individual birds during the nesting season.

4.12.1.1.2.8 Ferruginous Hawk

Potential adverse impacts to this species under the Proposed Action would include both short-term construction disturbance and long-term surface disturbance. Ferruginous hawks are particularly sensitive to human disturbance during incubation and brooding, so impacts surrounding their nest localities would be of special concern, as disturbance during construction, drilling, or completion activities would increase the risk of nest/brood abandonment by adult hawks, leading to the loss of eggs or young during the breeding season.

Under the Proposed Action, surface disturbance would occur within 0.5 mile of known ferruginous hawk nest sites; 585 acres (4.2%) of this buffer around ferruginous hawk nesting areas would be directly impacted under the Proposed Action (Table 4-115). Because of the documented sensitivity of ferruginous hawks to human activity (Parrish et al. 2002; UDWR 2003b), project development and operation within 0.5 mile of nest sites would decrease habitat suitability and reduce or preclude use of these nest sites during the life of the project.

Table 4-115. Surface Disturbance of Ferruginous Hawk Nest Buffer and Potential Foraging Habitat under Each Alternative

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
0.5-mile Nest Buffer						
Acres disturbed	585	515	677	172	184	258
Percentage disturbed	4.2%	3.7%	4.9%	1.2%	1.3%	1.8%
Potential Foraging Habitat						
Acres disturbed	5,958	4,329	7,534	1,701	1,679	2,628
Percentage disturbed	4.1%	3.0%	5.1%	1.2%	1.2%	1.8%

In addition to impacting nesting habitat, project activities would also potentially impact suitable ferruginous hawk foraging habitat. Approximately 146,294 acres of potential foraging habitat has been identified in the project area (see Section 3.12.2.2.5). Under the Proposed Action, surface disturbance would directly impact 5,958 acres (4.1%) of ferruginous hawk foraging habitat. The Proposed Action would result in greater adverse impacts to the ferruginous hawk than would occur under the No Action Alternative. Compared to the No Action Alternative, development under the Proposed Action would result in the disturbance of 413 more acres of the ferruginous hawk's nest buffers and 4,257 more acres of the hawk's potential foraging habitat. Not only would surface disturbance directly affect the amount of land available for foraging, but it would fragment and otherwise adversely impact prey populations such as small mammals, songbirds, and reptiles. The reduction of prey base has been identified by natural resource agencies as a primary cause of ferruginous hawk population decline (Parrish et al. 2002; UDWR 2003b).

Other adverse impacts of proposed project activities include reduced nesting success from the removal of potential nesting trees, and increased risk of direct mortality due to impacts with vehicles on roads (while feeding on carrion).

In summary, although specific nest protection measures (e.g., moving wells out of line of sight from the nest, and noise-reduction measures) would be applied as applicant-committed measures, increased well development in the project area could reduce ferruginous hawk nesting attempts and nesting success.

Applicant-committed measures and BMPs would minimize adverse impacts to ferruginous hawks, especially during the breeding season. Vernal RMP BMPs requires a 0.5-mile construction buffer around active raptor nest sites during the breeding season (see Section 2.2.9.6 and Table 2-1 for applicant-committed BMPs pertaining to ferruginous hawks). This measure reduces the risk of direct mortality during the breeding season.

Ferruginous Hawk Determination (Proposed Action)

Implementation of the Proposed Action may affect individuals, but is **not likely to contribute to the need to become listed.**

Rationale for Ferruginous Hawk Determination (Proposed Action)

Although 5,958 acres of foraging habitat and 585 acres of nesting habitat would be directly impacted by the Proposed Action, potentially impacting the local population of ferruginous hawks through displacement and habitat loss or degradation, this constitutes a small percentage of suitable habitat available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat and eliminate direct impacts to individual birds during the nesting season.

4.12.1.1.2.9 Bald Eagle

No bald eagle nest sites are known to occur within the project region. Consequently, no direct impacts to nesting bald eagles would be anticipated from the proposed project. Impacts to wintering bald eagles would include the long-term surface disturbance, habitat fragmentation, and human disturbance of approximately 91 acres of known winter roosting habitat within 0.5 mile of known winter roosting areas. This is approximately 2.2% of the known bald eagle winter roosting habitat in the project area that would be affected by surface disturbance (Table 4-116). In addition, approximately 11 acres (or 0.9%) of all potential roosting habitat (riparian) in the project area would be directly impacted. The Proposed Action would result in the disturbance of 41 more acres around roosting sites, six more acres of potential roosting habitat, and 325 more miles of road than the No Action Alternative. Table 4-116 provides a comparison of the number acres of bald eagle habitat directly impacted by each alternative.

Table 4-116. Surface Disturbance within 0.5 Mile of Known Bald Eagle Roosting Sites, Surface Disturbance of Potential (Riparian) Roosting Habitat, and Total Length of New Roads in the Project Area under Each Alternative

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
0.5-mile Roost Site Buffer						
Acres disturbed	91	63	68	50	24	0
Percentage disturbed	2.2%	1.5%	1.6%	1.2%	0.6%	0.0%
Potential (Riparian) Roosting Habitat						
Acres disturbed	11	0	4	0	0	0
Percentage disturbed	0.9%	0.0%	0.3%	0.0%	0.0%	0.0%
Roads						
Miles of new roads	325	274	526	72	106	198

Human disturbance of bald eagles' winter roosting habitat may cause avoidance and temporary displacement from these areas. Because bald eagles will feed on roadside carrion (particularly during winter), the risk of being struck by a vehicle would increase under the Proposed Action due to increased traffic levels and a 325-mile expansion of the road network. An increased road network and enhanced public access would also increase the risk of bald eagles being illegally shot.

The Proposed Action would result in the disturbance of 41 more acres around roosting sites, six more acres of potential roosting habitat, and 325 more miles of road than the No Action Alternative.

Bald Eagle Determination (Proposed Action)

Implementation of the Proposed Action may affect individuals, but is **not likely to contribute to the need to become listed**.

Rationale for Bald Eagle Determination (Proposed Action)

Although 91 acres of bald eagle winter roosting habitat within 0.5 mile of known winter roosting areas and 11 acres of potential winter roosting habitat would be directly impacted by the Proposed Action, this constitutes a small percentage of suitable habitat available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat and eliminate direct impacts to individual birds during the nesting season.

4.12.1.1.2.10 Golden Eagle

Short- and long-term direct and indirect impacts of the Proposed Action on golden eagles are identical to those described in Section 4.12.1.1.3.1, Raptors, below. All applicant-committed measures will be followed as stated in Section 2.2.9.6.

As stated in Section 3.12.3.1.1, a total of 30 golden eagle nests have been identified in the project area, encompassing 11,690 acres of land within 0.5 mile of a known nest. Compared to the No Action Alternative, development under the Proposed Action would result in the disturbance of 557 acres of land within 0.5 mile of known golden eagle nests; the No Action Alternative would impact 141 acres of nest buffer area. Table 4-117 below displays the number of acres of surface disturbance within 0.5 mile of nests.

Table 4-117. Acres Disturbed within 0.5 Mile of Golden Eagle Nests for Each Alternative

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Half-mile buffer acreage	557	507	558	141	204	224

Temporal and spatial buffers apply to these nests, and will be prescribed during site-specific surveys. The activity of each nest will also be determined during site-specific surveys. The disturbance of nests and buffer areas is negligible due to applicant-committed measures and BMPs.

Golden Eagle Determination (Proposed Action)

Implementation of the Proposed Action is **not likely to contribute to the need to become listed**.

Rationale for Golden Eagle Determination (Proposed Action)

Although 557 acres surface disturbance within 0.5 mile of known golden eagle nests would be directly impacted by the Proposed Action, this constitutes a small percentage of suitable habitat available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat and eliminate direct impacts to individual birds during the nesting season.

4.12.1.1.2.11 Short-eared Owl

Direct, adverse impacts to short-eared owls under the Proposed Action would primarily include loss of nesting and foraging habitat. However, no short-eared owl nests were located during surveys (by the UDWR, the BLM, and SWCA in spring 2006) of the project area. In addition, the owl is an infrequent nester in Utah, and is typically found nesting only in the northwest part of the state (UDWR 2007).

As stated in Section 3.12.2.2.8, approximately 146,294 acres of potential habitat exists for short-eared owls in the project area. Under the Proposed Action, approximately 5,958 acres (4.1%) of surface disturbance would directly impact potential short-eared owl habitat. The Proposed Action would result in greater adverse impacts to the short-eared owl than would occur under the No Action Alternative. Compared to the No Action Alternative, development under the Proposed Action would result in the disturbance of 4,257 more acres of short-eared owl habitat. Table 4-118 provides a comparison of the acres of potential habitat directly impacted by each alternative.

Table 4-118. Surface Disturbance of Short-eared Owl Potential Habitat under Each Alternative

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Acres disturbed	5,958	4,329	7,534	1,701	1,679	2,178
Percentage disturbed	4.1%	3.0%	5.1%	1.2%	1.1%	1.8%

In order to reduce impacts to breeding short-eared owls, Gasco has committed to conducting presence/absence surveys within areas of suitable breeding habitat and, as applicable, would implement seasonal and spatial constraints as identified in Section 2.2.9. Implementation of this measure would reduce the risk of project-related mortality during the breeding season.

Short-eared Owl Determination (Proposed Action)

Implementation of the Proposed Action may impact individuals, but is **not likely to contribute to the need to become listed**.

Rationale for Short-eared Owl Determination (Proposed Action)

Although 5,958 acres surface disturbance of potential short-eared owl habitat would be directly impacted by the Proposed Action, this constitutes a small percentage of such habitats available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat and eliminate direct impacts to individual birds during the nesting season.

4.12.1.1.2.12 Lewis' Woodpecker

Lewis' woodpecker occurs in pine forests, riparian areas, and pinyon-juniper woodlands. Breeding by this species has been observed in Ouray and Uintah counties and along Pariette Wash (Kingery 1998; UDWR 2007) and is uncommon along the Green River. Direct impacts to Lewis' woodpecker include the loss of nesting, foraging, and wintering habitat, which leads to the displacement of individuals, and possibly to reduced productivity. Indirect impacts include habitat fragmentation.

Approximately 41,529 acres of Lewis' woodpecker habitat (nesting, foraging, and wintering) occurs in the project area. A total of 1,174 (2.8%) acres of Lewis' woodpecker habitat would be directly impacted by the Proposed Action. The Proposed Action would result in greater impacts to Lewis' woodpecker than would occur under the No Action Alternative. Compared to the No Action Alternative, development under the Proposed Action would result in the disturbance of 887 more acres of Lewis' woodpecker habitat. Table 4-119 below displays the acres of habitat disturbed for each alternative.

Table 4-119. Surface Disturbance of Lewis' Woodpecker Potential Habitat under Each Alternative

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Acres disturbed	1,174	996	1,740	287	134	706
Percentage disturbed	2.8%	2.4%	4.2%	0.7%	0.3%	1.7%

In order to reduce impacts Lewis' woodpeckers during breeding, presence/absence surveys within areas of suitable breeding habitat would be conducted during the breeding season, and seasonal and spatial buffers would be applied. Implementation of this measure would reduce the risk of project-related mortality during the breeding season.

Lewis' Woodpecker Determination (Proposed Action)

Implementation of the Proposed Action may impact individuals, but is **not likely to contribute to the need to become listed**.

Rationale for Lewis' Woodpecker Determination (Proposed Action)

Although 1,174 acres of surface disturbance of potential Lewis' woodpecker habitat would be directly impacted by the Proposed Action, this constitutes a small percentage of such habitats available both within the project area and throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat, and eliminate direct impacts to individual birds during the nesting season.

4.12.1.1.2.13 Mountain Plover

In Utah, the mountain plover is known to breed only on Myton Bench in Duchesne County (UDWR 2011). The primary direct impact of the Proposed Action would be the loss of breeding habitat as mountain plovers have been shown to exhibit very specific habitat requirements for breeding. The species is known to breed in open habitats, including along roadsides and oil or gas well pads; therefore, direct impacts of the project could include vehicle mortality of adults and young near roads (Manning and White 2001). Indirect impacts would include the further fragmentation of breeding habitat.

Approximately 22,500 acres of known mountain plover breeding habitat have been identified within the project area. Under the Proposed Action, approximately 720 (3.2%) acres would be directly impacted. Compared to the No Action Alternative, development under the Proposed Action would result in approximately 221 more acres of disturbance in mountain plover breeding habitat. Table 4-120 provides a detailed breakdown of acreages affected under each alternative.

Table 4-120. Surface Disturbance of Mountain Plover Known Breeding Habitat under Each Alternative

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Acres disturbed	720	487	1,326	499	284	236
Percentage disturbed	3.2%	2.2%	5.8%	2.2%	1.2%	1.0%

To limit impacts to mountain plover species, construction would take place outside of the breeding season (May 1–June 15) so as to minimize disturbance to birds that may be breeding (BLM 2008c).

Mountain Plover Determination (Proposed Action)

Implementation of the Proposed Action may impact individuals, but is **not likely to contribute to the need to become listed**.

Rationale for Mountain Plover (Proposed Action)

Although 720 acres of surface disturbance of potential mountain plover habitat would be directly impacted by the Proposed Action, this constitutes a small percentage of such habitats available both within the project area and throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat, and eliminate direct impacts to individual birds during the nesting season.

4.12.1.1.2.14 Sensitive Fish Species

The roundtail chub, bluehead sucker, and flannelmouth sucker are listed by the State of Utah and the BLM as sensitive species. All of these fish are Colorado River system endemics, and would be negatively affected by the Proposed Action's impacts to the Green River. Impacts to these three species under the Proposed Action would be the same as the impacts to federally listed Colorado River fish, as described in Section 4.12.1.1.1.11.

Colorado River Sensitive Fish Determinations (Proposed Action)

The Proposed Action may impact individuals, but is **not likely to contribute to the need to become listed**.

Colorado River Sensitive Fish Determination Rational (Proposed Action)

1) Green River depletions:

   Due to the cumulative impacts of incrementally small water depletions in the Colorado River basin, the Proposed Action's water usage may affect all of the Colorado River sensitive fish considered. However, the Proposed Action would constitute no more than a 0.005% incremental depletion to low flow conditions (as described in Section 4.12.1.1.1.11), and is therefore unlikely to contribute to the need for federal listing.

2) Risk of spills from wells and pipelines in the Green River floodplain:

   The Proposed Action may affect these fish, due to increased risk of condensate spill within Green River floodplain or tributaries, but is unlikely to lead to their federal listing because of the low risk of a spill exceeding toxic concentrations in the Green River due to applicant-committed spill prevention measures including pipeline burial under stream crossings and the use of shut-of valves. In addition, applicant-committed BMPs for the site-specific use of buried pipelines and centralized water and condensate tank facilities would reduce the risk of spills from tanks and pipelines.

3) Sedimentation:

   The Proposed Action may affect Colorado River fish, due to slight increase in sedimentation and sediments containing selenium and boron, but is unlikely to lead to the listing of these fish because of the minimal (0.03%) increase in the sediment load of the Green River (see Table 4-131 in Section 4.15.1.1.2.2).

4.12.1.1.3 Other Special Status Species Retained for Analysis

4.12.1.1.3.1 Raptors

The Proposed Action would result in direct adverse long-term impacts to breeding, nesting, and wintering raptors. The level of these impacts would depend on the location of the proposed wells and access roads relative to occupied territories, active or inactive nest sites, wintering areas, and foraging areas. Well development or road construction in proximity to an active nest during the breeding season would likely result in nest abandonment (a direct adverse effect) and mortality of young (an indirect, adverse effect). Nearby roads and well pads would prevent a nest from being used in the future, because many species of raptors alternate between nest sites within a breeding territory and tend to avoid nest sites near disturbances (Richardson and Miller 1997; Kruger 2002). Raptors in the project area are generally wide ranging and use a variety of habitat types for breeding, nesting, and foraging. Because of the diversity of habitats used, and raptors' sensitivity to nesting disturbances, impacts to raptors are analyzed according to the amount of projected disturbance with the potential to disturb known nest sites under each alternative. Surface disturbance within occupied territory and foraging areas would be directly related to the amount of surface disturbance under each alternative (as discussed throughout this chapter), and could reduce the prey base, cause displacement to other areas, and increase the risk of roadway mortality.

BMPs generally require a 0.25 to 0.5-mile construction buffer around active nest sites from courtship through fledging, with the assumption that this buffer would allow space for even the more sensitive raptor species (such as ferruginous hawks; Parrish et al. 2002) to remain undisturbed. Specific timing and distance stipulations are listed in Table 4-121 below, and are consistent with both the Vernal FO RMP's *Best Management Practices for Raptors and Their Associated Habitats in Utah* (BLM 2008b). Active nests are defined by the BLM Vernal FO as nests that are in use or have been used in the most recent 2 years; however, some raptors will refurbish a nest that has been out of use for more than 2 years if it is in a preferred location. If we assume that a 0.5-mile buffer constitutes a defined area around a single nest, then the sum of these buffered nesting areas totals 37,900 acres across the project area. Under the Proposed Action, 1,745 acres (4.6%) of this buffered nesting area would be directly impacted (Table 4-122). This is more than 4 times more disturbance in buffered raptor nesting areas than under the No Action Alternative, where 417 acres (1.1%) of buffered raptor nesting area would be directly converted to well pads and roads (see Table 4-122).

Table 4-121. Raptor Nest Buffers and Timing Constraints

Species	Distance from Active Nest	Timing Constraints
American Kestrel	--[1]	Apr 1–Aug 15
Burrowing Owl	0.25 mile	Mar 1–Aug31
Cooper's Hawk	0.5 mile	Mar 15–Aug 31
Great Horned Owl	0.25 mile	Feb 1–Sep 31
Long-eared Owl	0.25 mile	Feb 1–Aug 15
Merlin	0.5 mile	Apr 1–Aug 31
MSO	0.5 mile	Mar 1– Aug 31
Northern Goshawk	0.5 mile	Jan 1–Aug 15
Northern Harrier	0.5 mile	Apr 1–Aug 15
Osprey	0.5 mile	Apr 1–Aug 31
Peregrine Falcon	0.25 mile	Feb 1 – Aug 31
Prairie Falcon	0.25 mile	Apr 1–Aug 31
Red-tailed Hawk	0.5 mile	Mar 15–Aug 15
Sharp-shinned Hawk	0.5 mile	Mar 15–Aug 31
Short-eared Owl	0.25 mile	Mar 1–Aug 1
Swainson's Hawk	0.5 mile	Mar 1–Aug 31
Turkey Vulture	0.5 mile	May 1–Aug 15

[1] Due to apparent high population densities and ability to adapt to human activity, a spatial buffer is not currently considered necessary for maintenance of American kestrel populations. Actions resulting in direct mortality of individual birds or taking of known nest sites are unlawful.

Table 4-122. Surface Disturbance and New Roads within 0.5-mile Radius of Raptor Nest Sites under Each Alternative

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Acres (and percentage) disturbed	1,745 (4.6%)	1,348 (3.6%)	1,711 (4.5%)	417 (1.1%)	489 (1.3%)	779 (2.1%)
Miles of new roads	93	68	90	15	27	44

All well locations and access roads would be sited as far from active raptor nests as possible to a minimum of 0.25 mile, according to the spatial buffers listed in Table 4-121. Work locations and access roads would be topographically concealed from nests as feasible. Compliance with these restrictions is important even for inactive nests because not all raptor pairs breed every year or consistently reuse the same nest within a nesting territory. Many individual raptor nests left unused for a number of years are eventually reoccupied.

With a marked increase in roads in the project area, as under the Proposed Action (325 miles of new roads, a 58% increase over current conditions), increased risk of vehicle-collision fatalities with raptors would be an adverse indirect impact. Raptors that are scavengers are at increased risk of vehicle impact as they forage on road-killed carcasses. Additionally, several species of owl, including short-eared, great-horned, and barn, often hunt near roads at approximately the same height as automobile windshields (Jacobson 2005). Depending on the species of raptor and vehicle speeds, the impacts of proposed roads will vary.

A marked increase in roads in the project area would also result in increased potential for illegal shooting of raptors (an indirect adverse effect) given the increased level of public access that additional project roads would provide. There are currently 133 miles of roads in buffered raptor nesting areas. Under the Proposed Action, 93 miles of new roads (a 70% increase over current conditions) would be built within a 0.5-mile radius of buffered raptor nesting areas. This represents approximately 6 times more new roads in buffered raptor nesting areas than are in the No Action Alternative (15 miles of new roads, a 12% increase over current conditions; see Table 4-122).

Raptor Determination (Proposed Action)

Implementation of the Proposed Action may impact individuals, but is **not likely to contribute to the need to become listed**.

Rationale for Raptor Determination (Proposed Action)

While the Proposed Action could potentially result in direct and indirect adverse impacts to raptor buffered nesting habitat, the probability is relatively low based on the percentage of habitat that could be disturbed during the life of the project. Based on this analysis, BLM stipulations, and applicant-committed measures, the BLM has determined that the Proposed Action would not likely contribute to the need for federal listing.

4.12.1.1.3.2 Migratory Birds

Under the Proposed Action direct adverse impacts to migratory birds would come from the conversion of land within various birds' habitats to well pads, roads, and evaporative facilities. Loss of habitat would include reduced forage, cover, perches, and nesting areas for birds. A total of approximately 7,583 acres (4%) of land within migratory bird habitat would be directly impacted by the Proposed Action (Table 4-123). This is approximately 3.7 times more than under the No Action Alternative, where 2,053 acres (1%) of habitat would be converted (see Table 4-123). The majority of surface disturbance under the Proposed Action would be in scrub/shrub habitats (4,879 acres), and therefore migratory bird species associated with this habitat type would be most heavily affected (see Table 4-123). Surface disturbance in habitat types such as evergreen forest (926 acres), barren lands (657 acres), grasslands/herbaceous (591 acres), woody wetland and open water (326 acres), and disturbed and agricultural land (204 acres) would also occur under the Proposed Action. Under the Proposed Action, surface disturbance in these habitat types would be between 3.4 and 4.9 times more than under the No Action Alternative (see Table 4-123).

Table 4-123. Acres of Surface Disturbance (and Percentage of Habitat Type Disturbed) in Migratory Bird Species Habitat by Alternative

SWReGAP Habitat Type	Associated Migratory Bird Species	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Scrub/shrub 119,091 acres	Black-throated gray warbler[1, 2], Brewer's sparrow[2], loggerhead shrike[2], mountain plover[2], sage sparrow[1, 2], Virginia's warbler[1, 2], black-chinned hummingbird, black-throated sparrow, common raven, gray flycatcher, green-tailed towhee, horned lark, sage thrasher	4,879 (4.10%)	3,494 (2.93%)	6,224 (5.23%)	1,428 (1.20%)	1,369 (1.15%)	2,165 (1.8%)
Evergreen forest 30,430 acres	Black-throated gray warbler[1, 2], Brewer's sparrow[2], broad-tailed hummingbird[2], Virginia's warbler[1, 2], black-chinned hummingbird, common raven, gray flycatcher	926 (3.04%)	821 (2.70%)	1,332 (4.38%)	190 (0.62%)	304 (1.00%)	576 (1.9%)
Barren lands 29,659 acres	Common raven, horned lark	657 (2.22%)	506 (1.71%)	1,090 (3.68%)	152 (0.51%)	183 (0.62%)	397 (1.3%)
Grasslands/ herbaceous 14,562 acres	Brewer's sparrow[2], loggerhead shrike[2], mountain plover[2], sage sparrow[1, 2], common raven, gray flycatcher, green-tailed towhee, horned lark, sage thrasher, vesper sparrow, western kingbird	591 (4.06%)	523 (3.59%)	730 (5.01%)	134 (0.92%)	210 (1.44%)	309 (2.1%)
Woody wetland and open water 8,031 acres	Brewer's sparrow[2], broad-tailed hummingbird[2], sage sparrow[1, 2], loggerhead shrike[2], black-chinned hummingbird, common raven, horned lark, yellow-breasted chat, mallard, gadwall, cinnamon teal, pintail, Canada goose, heron, egret, sandpiper, black-necked stilt, white-faced ibis, American white pelican, sandhill crane	321 (4.00%)	213 (2.65%)	351 (4.37%)	94 (1.17%)	65 (0.81%)	98 (1.3%)
Disturbed and agricultural land 5,053 acres	Broad-tailed hummingbird[2], loggerhead shrike[2], black-chinned hummingbird, common raven, horned lark, house finch, vesper sparrow, western kingbird, sandhill crane	204 (4.04%)	128 (2.53%)	252 (4.99%)	55 (1.09%)	43 (0.85%)	56 (0.01%)
Total 206,826 acres		7,583 (3.67%)	5,685 (2.8%)	9,979 (4.8%)	2,053 (1%)	2,174 (1.05%)	3,601 (1.74%)

[1]Birds of Conservation Concern species (see Section 3.12.3.2., Migratory Birds).
[2]Partners in Flight species (see Section 3.12.3.2., Migratory Birds).

Impacts of Habitat Fragmentation on Migratory Birds

GIS models were created to analyze the degree of habitat fragmentation under each alternative. Models were based on the BLM's best available GIS data for existing roads (not including the county transportation plan) within the project area. For migratory birds, the model used SWReGAP vegetation data. Only road effects were considered in the models. Individual well pads were considered to be endpoints for proposed roads. Pipelines were also assumed to have minimal effect on fragmentation because more than 99% of proposed pipelines (under all alternatives) run along roads and are therefore accounted for by analyzing road effects.

The distribution of new roads was determined through the alternatives development process. Existing roads would be used under each alternative, and therefore the habitat fragmentation analysis considered the effects, on each wildlife species examined, of existing roads along with proposed new roads within the project area. Model runs involved habitat fragmentation calculations where habitat coverages were combined with well and road distribution coverages to determine fragment acreages by alternative and species. Although other birds use the habitats listed in Table 4-124, the migratory birds shown were selected for analysis because many of them are found on lists of sensitive species (noted in Table 4-123 and Table 4-124). The presence of roads can have many adverse effects on avian communities, including displacement, loss of habitat, and vehicle-related mortalities. Vehicles often hit and kill birds that are attracted to roadside vegetation, spilled grain, or dead animals (Forman and Alexander 1998).

Fragmentation of migratory bird habitat was assessed by calculating the acreage and percentage of migratory bird habitat that would be impacted by vehicle traffic. Because numerous migratory bird species use various habitats in the project area, impacts were analyzed based on habitat types, which could then be extrapolated to specific bird species (see Table 4-124). The potential area of impact was assumed to be a 1,300-foot buffer along each side of all roads in potential migratory bird habitat in the project area. This buffer represents an average disturbance distance based on applicable literature (Clark and Karr 1979; Connelly et al. 2000; Crawford et al. 2004; UDWR 2002b).

Table 4-124 shows acres of potential habitat in the project area for each bird species, the number of acres and the percentage of unfavorable habitat due to existing roads only, and the number of acres and the percentage of unfavorable habitat under the Proposed Action, No Action, and Alternatives B and C. Taking into account only existing roads, 121,111 acres (59%) of migratory bird habitat in the project area is unfavorable due to habitat fragmentation. Under the Proposed Action, 77% (162,307 acres) of the total migratory bird habitat in the project area would be unfavorable (a 34% increase over current conditions). Under the Proposed Action, there would be approximately 20% more unfavorable habitat than under the No Action Alternative where 66% (135,768 acres) of migratory bird habitat in the project area would be unfavorable due to habitat fragmentation (a 12% increase over current conditions) (see Table 4-124). Migratory birds that use the scrub/shrub habitat type would be most heavily impacted as more than half the total habitat fragmentation would occur in this vegetation type under the Proposed Action and the No Action Alternatives; however, impacts would be less severe under the No Action Alternative because 14% less disturbance would occur in the scrub/shrub vegetation type.

Table 4-124. Habitat Fragmentation in Migratory Bird Species Habitat by Alternative (Percentage of Habitat Fragmented)

Habitat Type by Acre	Associated Migratory Bird Species	Fragmentation from Existing Roads Only	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Scrub/shrub 119,091 acres	Black-throated gray warbler[1, 2], Brewer's sparrow[2], loggerhead shrike[2], mountain plover[2], sage sparrow[1, 2], Virginia's warbler[1, 2], black-chinned hummingbird, black-throated sparrow, common raven, gray flycatcher, green-tailed towhee, horned lark, sage thrasher	73,910 (62%)	96,234 (81%)	89,937 (76%)	113,571 (95%)	82,954 (70%)	83,838 (70%)	92,061 (77%)
Evergreen forest 30,430 acres	Black-throated gray warbler[1, 2], Brewer's sparrow[2], broad-tailed hummingbird[2], Virginia's warbler[1, 2], black-chinned hummingbird, common raven, gray flycatcher	14,883 (49%)	23,175 (76%)	22,693 (75%)	29,064 (96%)	17,336 (57%)	19,446 (64%)	22,290 (73.25%)
Barren lands 29,659 acres	Common raven, horned Lark	14,088 (47%)	19,939 (67%)	18,734 (63%)	25,859 (87%)	15,464 (52%)	16,174 (55%)	18,734 (63%)
Grasslands/ herbaceous 14,562 acres	Brewer's sparrow[2], loggerhead shrike[2], mountain plover[2], sage sparrow[1, 2], common raven, gray flycatcher, green-tailed towhee, horned lark, sage thrasher, vesper sparrow, western kingbird	9,357 (64%)	12,329 (85%)	12,184 (84%)	13,838 (95%)	10,345 (71%)	11,284 (77%)	11,790 (81%)

Table 4-124. Habitat Fragmentation in Migratory Bird Species Habitat by Alternative (Percentage of Habitat Fragmented)

Habitat Type by Acre	Associated Migratory Bird Species	Fragmentation from Existing Roads Only	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Woody wetland and open water 8,031 acres	Brewer's sparrow[2], broad-tailed hummingbird[2], sage sparrow[1, 2], loggerhead shrike[2], black-chinned hummingbird, common raven, horned lark, yellow-breasted chat, mallard, Gadwall, Cinnamon Teal, pintail, Canada goose, heron, egret, sandpiper, black-necked stilt, white-faced ibis, American white pelican, sandhill crane	5,184 (65%)	6,273 (78%)	5,806 (72%)	7,071 (88%)	5,819 (72%)	5,544 (69%)	5,926 (74%)
Disturbed and agricultural land 5,053 acres	Broad-tailed hummingbird[2], loggerhead shrike[2], black-chinned hummingbird, common raven, horned lark, house finch, vesper sparrow, western kingbird, sandhill crane	3,689 (73%)	4,358 (86%)	4,423 (84%)	4,686 (93%)	3,850 (76%)	3,837 (76%)	4,215 (84%)
Total 206,826 acres		121,111 (59%)	162,307 (77%)	153,777 (74%)	194,089 (94%)	135,768 (66%)	140,286 (68%)	155,017 (75%)

[1]Birds of Conservation Concern species (see Section 3.12.3.2. Migratory Birds).
[2]Partners In Flight species (see Section 3.12.3.2., Migratory Birds).

Increased risk of bird mortality due to impacts with vehicles on access roads would be a potential long-term adverse impact to birds in the project area. In road mortality studies, birds have been found to be the most commonly killed group of animals; 60 million or more birds are killed each year on roads in the United States (Jacobson 2005). There are currently 524 miles of roads in migratory bird habitat in the project area. Approximately 325 miles of new roads (a 58% increase over current conditions) would be constructed in migratory bird habitat under the Proposed Action compared to 72 miles of new roads (a 13% increase over current conditions) under the No Action Alternative. Under the Proposed Action, there would be an estimated 6.7% maximum increase in traffic volume over current conditions (see Section 4.5, Table 4-75).

The construction of new roads would also have indirect impacts associated with habitat fragmentation (discussed in detail in Section 4.16.1.1.7) and noise disturbances. Noise disturbance promotes avoidance behavior from migratory birds and has the potential to displace birds, thereby increasing bird density and competition for resources in other areas. Birds rely on song to defend territories and attract mates, and if traffic noise keeps them from hearing each other, they may move away from roads (Jacobson 2005). In addition, as roads alter the behavior of and fragment populations of large carnivores such as mountain lions (Section 4.16.1.1.2), birds can suffer increased predation from smaller carnivores such as skunks, foxes, and coyotes (Jacobson 2005). For the aforementioned reasons, habitat within 1,300 feet along the edges of proposed roads would lose functional value for the birds, or 162,307 acres under the Proposed Action. This buffer represents an average disturbance distance based on applicable literature (Clark and Karr 1979, Connelly et al. 2000, Crawford et al. 2004, UDWR 2002b).

Migratory Birds Determination (Proposed Action)

Implementation of the Proposed Action may impact individuals, but is **not likely to contribute to the need to become listed**.

Rationale for Migratory Birds Determination (Proposed Action)

None of the migratory birds considered are proposed for listing under the ESA or included on the BLM sensitive species list. Although impacts within the project area could adversely affect local populations or individuals, a relatively small percentage of each species' habitat within their entire range would be impacted by the Proposed Action. In addition, no more than 5% of each species' habitat within the project area would be directly impacted (Table 4-123) under the Proposed Action. Based on this analysis, the BLM has determined that the Proposed Action would not contribute to the need for federal listing of any of these migratory bird species.

4.12.1.2 Alternative B: Reduced Development

4.12.1.2.1 Federally Listed Threatened, Endangered, and Candidate Species

4.12.1.2.1.1 Impacts Common to Several Species

These would be of the same nature as described for the Proposed Action (see Section 4.12.1.1).

4.12.1.2.1.2 Clay Reed-mustard

Impacts to clay reed-mustard under Alternative B would be the same as under the Proposed Action; no occupied or suitable clay reed-mustard habitat areas would be disturbed.

Clay Reed-mustard Determination (Alternative B)

Implementation of Alternative B **may affect, but is not likely to adversely affect** the species.

Rationale for Clay Reed-mustard Determination (Alternative B)

The rationale for this determination under Alternative B is the same as described for the Proposed Action.

4.12.1.2.1.3 Shrubby Reed-mustard

Impacts to shrubby reed-mustard under Alternative B would be of the same nature as under the Proposed Action, but would directly affect 19 acres (1.3%) of the Badlands Cliff shrubby reed-mustard habitat area (see Map 37). This is 8 fewer acres (0.5%) than the Proposed Action and approximately 19 more acres of disturbance than would occur under the No Action Alternative.

This alternative would have fewer potential indirect impacts due to reduced road development in and adjacent to the Badlands Cliff shrubby reed-mustard habitat area. As shown above in Table 4-100, 174 acres of the Badlands Cliff shrubby reed-mustard habitat area occur within 300 feet of existing and proposed roads. For the purposes of this analysis, this acreage would be at increased risk for the indirect impacts listed under the Proposed Action. This represents 66 (61%) more acres than the No Action Alternative.

Shrubby Reed-mustard Determination (Alternative B)

Implementation of Alternative B **may affect, and is likely to adversely affect** the species.

Rationale for Shrubby Reed-mustard Determination (Alternative B)

The rationale for this determination under Alternative B is the same as described for the Proposed Action. However, the potential impacts to the species would be slightly less than those under the Proposed Action, as described above.

4.12.1.2.1.4 Pariette Cactus

Impacts to Pariette cactus under Alternative B would be of the same nature as under the Proposed Action, and would not directly impact potential Pariette cactus habitats (see Map 37). Under Alternative B, there would be no direct impacts to the 2009 Pariette cactus core conservation areas, which contain nesting and foraging habitat for the species' insect pollinators (see Table 4-101). Potential indirect impacts to potential habitats from fugitive dust, invasive weeds, and increased access to habitat areas associated with road development would be the same as under the Proposed Action, and slightly less than would occur under the No Action alternative. Approximately 24 acres of the 2009 Pariette cactus core conservation areas occur within 300 feet of existing and proposed roads or other surface disturbances where there would be increased potential for indirect impacts. Applicant-committed conservation measures would minimize the likelihood of direct disturbance of the species if it is encountered outside of its potential habitat and within project development areas.

Determination for Pariette Cactus (Alternative B)

Implementation of Alternative B **may affect, but is not likely to adversely affect** the species.

Rationale for Pariette Cactus Determination (Alternative B)

The rationale for this determination under Alternative B is the same as described for the Proposed Action.

4.12.1.2.1.5 Uinta Basin Hookless Cactus

Impacts to Uinta Basin hookless cactus (*Sclerocactus wetlandicus*) under Alternative B would be of the same nature as under the Proposed Action, but would impact fewer acres in the species' potential habitats (see Map 37). Alternative B would result in the disturbance of 2,674 acres (2.7%) of the species' potential habitats within the project area; 1,415 fewer acres than under the Proposed Action (see Table 4-102) Applicant-committed measures described in Appendix B would minimize the likelihood of direct disturbance of the species during project construction. Indirect impacts associated with roads described under the Proposed Action would occur along approximately 98 miles of new roads within the species' potential habitats under Alternative B. Approximately 22,664 acres of habitat would be within 300 feet of existing and proposed roads, making 23% of potential habitats within the project area more susceptible to the indirect impacts of fugitive dust, sedimentation, and fragmentation and degradation of the cactus' habitat or nesting and foraging habitats for the cactus' insect pollinators. Applicant-committed measures would minimize these risks, as described under the Proposed Action. The 2,674 acres of surface disturbance proposed in the cactus's potential habitats under Alternative B has the potential to contain approximately 4,171 plants (see Table 4-103), or up to 5,455 plants, including desiccants. In addition, approximately 2,380 spine clusters could be located in areas proposed for development under Alternative B.

This alternative would place 9,001 more acres within 300 feet of roads than the No Action Alternative. Overall, development under Alternative B would directly disturb approximately 1,670 more acres (1.7 times more) and approximately 12 more miles of road in Uinta Basin hookless cactus' habitat than under the No Action Alternative.

Determination for Uinta Basin Hookless Cactus (Alternative B)

Implementation of Alternative B **may affect, and is likely to adversely affect** the species.

Rationale for Uinta Basin Hookless Cactus Determination (Alternative B)

The rationale for this determination under Alternative B is the same as described for the Proposed Action. However, there would be slightly fewer potential adverse impacts to the species than under the Proposed Action, as described above.

4.12.1.2.1.6 Graham's Beardtongue

Impacts to Graham's Beardtongue occupied habitats (see Map 37) under Alternative B would be the same as under the Proposed Action.

Determination for Graham's Beardtongue (Alternative B)

Implementation of Alternative B **is not likely to jeopardize the continued existence of the species, and is not likely to destroy or adversely modify proposed critical habitat.**

Rationale for Graham's Beardtongue Determination (Alternative B)

The rationale for this determination under Alternative B is the same as described for the Proposed Action.

4.12.1.2.1.7 Ute Ladies'-tresses

Impacts to the Ute ladies'-tresses under Alternative B would be of the same nature as under the Proposed Action, but would not impact native riparian habitats where the species potentially occurs. Potential indirect impacts to the species would also be reduced due to 51 fewer miles of roads and associated fugitive dust, weed invasion, and sedimentation and impacts to pollinators due to habitat fragmentation than under the Proposed Action. Like the No Action Alternative, Alternative B would impact no riparian habitat, but potential for indirect impacts would be greater than the No Action Alternative due to 202 additional miles of road.

Determination for Ute Ladies'-tresses (Alternative B)

Implementation of Alternative B **may affect, but is not likely to adversely affect** the species.

Rationale for Ute Ladies'-tresses Determination (Alternative B)

The rationale for this determination under Alternative B is the same as described for the Proposed Action. However, the potential impacts to the species would be slightly less than those under the Proposed Action, as described above.

4.12.1.2.1.8 Mexican Spotted Owl (MSO)

Impacts to the MSO under Alternative B would be of the same nature as under the Proposed Action, but would affect fewer acres of the species' habitat. Approximately 4 acres, or 0.2%, of the MSO habitat classified as “good” in the project area would be disturbed by construction of roads, well pads, and ancillary facilities such as pipelines and evaporative facilities (Table 4-105). None of the MSO habitat classified as “fair” in the project area would be disturbed; and approximately 92 acres, or 0.6%, of the MSO habitat classified as “poor” would be disturbed (see Table 4-105). As stated in Section 2.2.9 (Applicant-committed Measures), all “fair” and “good” habitat below the rim of Nine Mile Canyon will be avoided; however, all of the MSO habitat that would be disturbed under Alternative B occurs above the rim of Nine Mile. Alternative B would result in slightly greater impacts to MSOs than would the No Action Alternative due to the disturbance of four more acres of “good” and 76 more acres of “poor” habitat. Alternative B would result in impacts to 25 acres of 0.5-mile buffers surrounding MSO habitat in the project area, which is 67 fewer acres than the Proposed Action (Table 4-105).

Mexican Spotted Owl Determination (Alternative B)

Implementation of Alternative B **may affect, but is not likely to adversely affect** the species.

Rationale for Mexican Spotted Owl Determination (Alternative B)

Although 4 acres of "good" and 92 acres of "poor" MSO habitat would be affected by Alternative B, this constitutes a small percentage of "good" habitat available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat and eliminate direct impacts to individual birds during the nesting season.

4.12.1.2.1.9 Greater Sage-grouse

Impacts to the greater sage-grouse under Alternative B would be the same as under the Proposed Action, but would affect 97 fewer acres within 2 miles of known leks, 786 fewer acres of brooding habitat, and 674 fewer acres of wintering habitat. Under Alternative B, approximately 744 acres of surface disturbance by well pads, roads, evaporation facilities, and pipeline corridors would occur within the 2-mile buffer around the known greater sage-grouse leks (see Table 4-106). This would comprise 9.3% of the 8,032 acres within the buffer zone. Approximately 2,262 acres of surface disturbance would occur within the 84,647 acres of UDWR-designated brooding habitat, constituting a conversion of 2.7% of total available acres within the project area. Roads proposed under Alternative B would contribute to the devaluation or degradation of 75% of the 84,647 acres of potential sage-grouse habitat in the project area. Approximately 1,593 acres of surface disturbance would occur within the 38,747 acres of UDWR-designated wintering habitat, constituting a conversion of 4.1% of total available acres in the project area.

Alternative B would result in more adverse impacts to the greater sage-grouse than would occur under the No Action Alternative. Compared to the No Action Alternative, development under Alternative B would impact 697 more acres within lek buffers, result in the disturbance of 1,399 more acres of potential breeding habitat, and fragment 4,593 more acres of potential brooding habitat. Additionally, it would impact 1,397 more acres of wintering habitat than the No Action Alternative.

Greater Sage-grouse Determination (Alternative B)

Implementation of Alternative B may impact and could lead to a downward population trend, but **would not likely contribute to the listing of the species**.

Rationale for Greater Sage-grouse Determination (Alternative B)

Although 744 acres within 2 miles of a known (inactive) lek, 2,262 acres of potential brooding habitat, and 1,593 acres of potential wintering habitat would be directly impacted by Alternative B, this constitutes a small percentage of such habitats available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat and eliminate direct impacts to individual birds during the nesting season.

4.12.1.2.1.10 Western Yellow-billed Cuckoo

Impacts to the WYBC under Alternative B would be of the same nature as under the Proposed Action, but would affect fewer acres of the species' habitat. Under Alternative B, 10 fewer acres of potential habitat (riparian vegetation) are anticipated to be impacted than under the Proposed Action, with a total of 1.6% (Table 4-107) of the total suitable riparian habitat in the project area impacted. Depending on the specific value of the riparian areas impacted within the project area, the impacts could be more or less severe.

Adverse impacts to the species would be mitigated by restricting new surface-disturbing activities within 330 feet of riparian areas. In wet meadows, springs, and seeps, surveys to assess riparian habitat on a case-by-case basis would take place prior to the initiation of any construction activities. If the species or habitat for the WYBC is found, then the area would be avoided if possible.

Western Yellow-billed Cuckoo Determination (Alternative B)

Implementation of Alternative B may impact and could lead to a downward population trend, but **would not likely contribute to the listing of the species.**

Rationale for Yellow-billed Cuckoo Determination (Alternative B)

Although 19 acres of suitable WYBC habitat would be directly impacted by Alternative B, this constitutes a small percentage of suitable habitat available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat and eliminate direct impacts to individual birds during the nesting season.

4.12.1.2.1.11 Threatened, Endangered, and Candidate Fish Species

Impacts to Colorado River fish under Alternative B would be of the same nature as those under the Proposed Action, but would result in impacts of lesser magnitude, including less depletion of the Green River, less disturbance of erosive soils, and a slightly lower risk of a pipeline spill. Under Alternative B, approximately 600 pipeline crossings of intermittent/ephemeral drainages that are tributary to the Green River would be required. Eight wells are proposed within the 100-year floodplain for the Green River, as well as 1.5 miles of roads and pipelines. An additional 23 wells are proposed within 100-year floodplains of Green River tributaries within 5 miles of the river, along with 11 miles of pipeline.

The risk of acute or chronic toxicity to endangered fish in the Green River in the event of a natural-gas condensate spill would be the same as under the Proposed Action, although the likelihood of a spill would be reduced. The 1.5 miles of pipeline in the Green River floodplain under Alternative B would carry a risk of 0.046 incident over their 30-year production phase use, or one incident every 657 years. The 11 miles of pipeline crossing floodplains within 5 miles of the Green River would carry a risk of 0.33 incident over the 30-year production phase over which each pipeline would be used, or one incident every 90 years. However, spill attenuation would greatly reduce the risk of a spill reaching the Green River before it evaporated.

Under Alternative B, approximately 215 acre-feet of water from the Green River Basin would be consumed over the lifetime of the project (see Table 4-108). Peak annual withdrawals from sources that feed the Green River would be the same as under the Proposed Action (approximately 23 acre-feet per year; see Table 4-129). This equates to approximately 0.04 cfs of withdrawal and would represent a loss of approximately 0.005% of the approximately 1,000 cfs recorded minimum stream flow of the Green River adjacent to the project area. This flow reduction would be considered a long-term (life of the project) impact in terms of reductions in habitat for listed fish species in the Green River.

Approximately 28 acres of water-erosive soils would be disturbed (see Table 4-108). Project-related disturbance would increase the Green River's sediment load by approximately 106,359 tons/year, or 0.03% (see Table 4-131, Section 4.15).

Alternative B would result in greater adverse impacts to Colorado River fish than would occur under the No Action Alternative. Compared to the No Action Alternative, development under Alternative B would consume 144 more acre-feet of water from the Green River Basin, result in the disturbance of 18 more acres of water-erosive soils, and require 127 more intermittent/ephemeral stream crossings by pipelines. Alternative B would also result in four more wells (and 0.9 more mile of pipeline) in the Green River floodplain, and 17 more wells (with 3.6 more miles of pipeline) crossing floodplains within 5 miles of the Green River.

Colorado River Endangered Fish Determinations (Alternative B)

Alternative B **may affect, and is likely to adversely affect,** all Colorado River endangered fish.

Colorado River Endangered Fish Determination Rational (Alternative B)

The rationale for the determination above is the same as described for the Proposed Action.

4.12.1.2.2 State of Utah and BLM Sensitive Species

4.12.1.2.2.1 Untermann Daisy

Impacts to the Untermann daisy under Alternative B would be of the same nature as those under the Proposed Action, but would affect 1,608 acres (3.5%) of potential Untermann daisy habitat in the project area (see Table 4-109; Map 37). Approximately 12,225.1 acres of Untermann daisy habitat would be effectively placed within 300 feet of existing and proposed roads under this alternative, 4,673 more acres than under the No Action Alternative. Overall, Alternative B would result in greater adverse impacts to the Untermann daisy than would occur under the No Action Alternative due to 4.7 times (1,327) more acres of disturbance and associated indirect impacts from fugitive dust, weed invasion, herbicides, and habitat fragmentation.

Determination for Untermann Daisy (Alternative B)

Implementation of Alternative B may affect individuals, but is **not likely to contribute to the need to become listed**.

Rationale for Untermann Daisy Determination (Alternative B)

The rationale for this determination under Alternative B is the same as described for the Proposed Action. However, the potential impacts to the species would be slightly less than those under the Proposed Action, as described above.

4.12.1.2.2.2 Sterile Yucca

Impacts to sterile yucca under Alternative B would be of the same nature as those under the Proposed Action, but would affect 0.15 acres (1.8%) of known sterile yucca habitat in the project area (see Table 4-110; Map 37). Approximately 4.6 acres of known sterile yucca habitat would be effectively placed within 150 feet of existing and proposed roads under this alternative, 1.1 fewer acres than under the No Action Alternative. Overall, Alternative B would result in slightly reduced adverse impacts to sterile yucca than would occur under the No Action Alternative due to 20% (1.1) fewer acres of disturbance and associated indirect impacts from fugitive dust, weed invasion, herbicides, and habitat fragmentation.

Sterile Yucca Determination (Alternative B)

Implementation of Alternative B may affect individuals, but is **not likely to contribute to the need to become listed**.

Rationale for Sterile Yucca Determination (Alternative B)

Because direct impacts to the sterile yucca's habitat would total less than than 2% of the known habitat available in the project area, and because considerable additional habitat exists beyond the project area, project-related activities are not likely to contribute to the need for federal listing of the species. In addition, site-specific avoidance and minimization measures, where required by the AO, would further reduce direct or indirect impacts to sterile yucca individuals and habitats.

4.12.1.2.2.3 Graham's Catseye, Barneby's Catseye, Goodrich's Blazingstar, Goodrich's Columbine, and Uinta Greenthread

Because the acreages of the potential habitats for these five species have not been mapped or determined for the project area, impacts are broadly described and compared between the action alternatives. In general, direct and indirect impacts to these five plant species under Alternative B would be comparable to the nature and degree of direct impacts described for other State of Utah and BLM sensitive plant species associated with similar Green River shale habitats, which would be the same as under the Proposed Action.

Graham's catseye, Barneby's catseye, Goodrich's blazingstar, Goodrich's columbine, and Uinta greenthread Determination (Alternative B)

Implementation of Alternative B may affect individuals, but is **not likely to contribute to the need for listing for any of the five species**.

Rationale for Graham's catseye, Barneby's catseye, Goodrich's blazingstar, Goodrich's columbine, and Uinta greenthread Determination (Alternative B)

Because additional habitats for Graham's catseye, Barneby's catseye, Goodrich's blazingstar, Goodrich's columbine, and Uinta greenthread exist beyond the project area, and because site-specific avoidance and minimization measures, where required by the AO, would further reduce direct or indirect impacts to individuals and habitats, project-related activities are not likely to contribute to the need for federal listing of these species.

4.12.1.2.2.4 White-tailed Prairie Dog

Impacts to the white-tailed prairie dog under Alternative B would be of the same nature as under the Proposed Action, but would affect fewer acres of known colonies. Surface-disturbing activities associated with the Proposed Action (e.g., the construction of well pads, pipelines, and access roads) would result in the loss of approximately 224 discontinuous acres of prairie dog habitat in the project area, or 1.4% of the habitat present (see Table 4-111). Alternative B would result in fewer adverse impacts to the white-tailed prairie dog than would occur under the No Action Alternative. Compared to the No Action Alternative, development under Alternative B would result in the disturbance of 113 fewer acres of the prairie dog's habitat.

White-tailed Prairie Dog Determination (Alternative B)

Implementation of Alternative B may affect individuals, but is **not likely to contribute to the need to become listed**.

Rationale for White-tailed Prairie Dog Determination (Alternative B)

The rationale for this determination under Alternative B is the same as described for the Proposed Action. In addition, the amount of habitat impacted by this alternative is considerably lower than the Proposed Action.

4.12.1.2.2.5 Big Free-tailed Bat

Impacts to the big free-tailed bat would be of the same nature as those described under the Proposed Action. Surface-disturbing activities under Alternative B would impact 119 acres of potential roosting habitat, and 3,958 acres of potential foraging habitat (see Table 4-112).

Alternative B would result in greater impacts to the big free-tailed bat than would occur under the No Action Alternative. Compared to the No Action Alternative, development under Alternative B would result in the disturbance of 88 more roosting acres and 2,417 more foraging acres of big free-tailed bat potential habitat.

Big Free-tailed Bat Determination (Alternative B)

Implementation of Alternative B may affect individuals, but is **not likely to contribute to the need to become listed**.

Rationale for Big Free-tailed Bat Determination (Alternative B)

The rationale for this determination under Alternative B is the same as described for the Proposed Action. In addition, the amount of big free-tailed bat potential habitat impacted by this alternative would be considerably lower than under the Proposed Action.

4.12.1.2.2.6 Spotted Bat

Impacts to the spotted bat would be of the same nature as those described under the Proposed Action. Surface-disturbing activities under Alternative B would impact 119 acres of potential roosting habitat, and 5,302 acres of potential foraging habitat (see Table 4-113). Alternative B would result in greater impacts to the spotted bat than would occur under the No Action Alternative. Compared to the No Action Alternative, development under Alternative B would result in the disturbance of 88 more roosting acres and 3,369 more foraging acres of spotted bat potential habitat.

Spotted Bat Determination (Alternative B)

Implementation of Alternative B may affect individuals, but is **not likely to contribute to the need to become listed**.

Rationale for Spotted Bat Determination (Alternative B)

The rationale for this determination under Alternative B is the same as described for the Proposed Action. In addition, the amount of big free-tailed bat potential habitat impacted by this alternative would be considerably lower than under the Proposed Action.

4.12.1.2.2.7 Burrowing Owl

Impacts to the burrowing owl under Alternative B would be of the same nature as under the Proposed Action, but would affect fewer acres within 0.5 mile of known owl nests. Under Alternative B, no habitat inside of the 0.5-mile nest buffer areas would be directly converted to well pads, roads, and other facilities (see Table 4-114). In addition, surface-disturbing activities under Alternative B (e.g., the construction of well pads, pipelines, and access roads) would result in the loss of approximately 224 acres of prairie dog/burrowing owl habitat in the project area (see Table 4-111). Alternative B would result in fewer adverse impacts to the burrowing owl than would occur under the No Action Alternative. Compared to the No Action Alternative, development under Alternative B would result in the disturbance of 14 fewer acres of the owl's habitat.

Burrowing Owl Determination (Alternative B)

Implementation of Alternative B may affect individuals, but is **not likely to contribute to the need to become listed**.

Rationale for Burrowing Owl Determination (Alternative B)

Although 224 acres of burrowing owl nesting habitat and 224 acres of prairie dog/burrowing owl habitat would be directly impacted by Alternative B, this constitutes a small percentage of suitable habitat available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat and eliminate direct impacts to individual birds during the nesting season. While Alternative B would result in direct and indirect adverse impacts to burrowing owls, the probability is relatively low based on the percentage of habitat that could be disturbed during the life of the project.

4.12.1.2.2.8 Ferruginous Hawk

Impacts to the ferruginous hawk under Alternative B would be of the same nature as under the Proposed Action, but would affect fewer acres within 0.5 mile of known hawk nests. Under Alternative B, 515 acres (3.7%) within the 0.5-mile buffer around ferruginous hawk nesting areas would be directly converted to well pads, roads, or other facilities (see Table 4-115). In addition, the construction of well pads and roads would disturb 4,329 acres (or 3.0%) of potential foraging habitat. Alternative B would result in greater adverse impacts to the ferruginous hawk than would occur under the No Action Alternative. Compared to the No Action Alternative, development under Alternative B would result in the disturbance of 343 more acres of the ferruginous hawk's nest buffers and 2,628 more acres of the hawk's potential foraging habitat.

Determination for Ferruginous Hawk (Alternative B)

Implementation of Alternative B may affect individuals, but **is not likely to contribute to the need to become listed.**

Rationale for Ferruginous Hawk Determination (Alternative B)

Although 4,329 acres of foraging habitat and 515 acres of nesting habitat would be directly impacted by Alternative B, this constitutes a small percentage of suitable habitat available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat and eliminate direct impacts to individual birds during the nesting season.

4.12.1.2.2.9 Bald Eagle

Impacts to bald eagles under Alternative B would be of the same nature as under the Proposed Action, but would affect fewer acres of the species' winter roosting habitat. Impacts to wintering bald eagles would include the long-term surface disturbance and fragmentation of approximately 63 acres of winter roosting habitat within 0.5 mile of known winter roosting areas. Approximately 1.5% of the bald eagle winter roosting habitat in the project area would be disturbed by construction of roads, well pads, and ancillary facilities such as pipelines (see Table 4-116). No acres of potential roosting habitat (riparian) in the project area would be disturbed. Road-associated impacts described under the Proposed Action would occur along approximately 274 miles of new roads within the project area under Alternative B. Alternative B would result in the disturbance of 13 more acres within 0.5 mile of known roosting sites, the same acreage of potential roosting habitat, and 202 more miles of road than the No Action Alternative.

Bald Eagle Determination (Alternative B)

Implementation of Alternative B may affect individuals, but is **not likely to contribute to the need to become listed**.

Rationale for Bald Eagle Determination (Alternative B)

Although 63 acres of bald eagle winter roosting habitat within 0.5 mile of known winter roosting areas would be directly impacted by Alternative B, this constitutes a small percentage of suitable habitat available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat and eliminate direct impacts to individual birds during the nesting season. While Alternative B could potentially result in direct and indirect adverse impacts to the bald eagle, the probability is relatively low based on the percentage of habitat that could be disturbed during the life of the project.

4.12.1.2.2.10 Golden Eagle

Short-term and long-term direct and indirect impacts of well development on golden eagles are identical to those described in Section 4.12.1.1.3.1, Raptors. All applicant-committed measures will be followed as stated in Section 2.2.9.6, Raptor Nests. Mitigation measures could also be followed, as stated in Section 4.12.2, below.

Surface-disturbing activities under Alternative B would impact 507 acres of nest buffer area (see Table 4-117). Temporal and spatial buffers apply to nests, and will be prescribed during site-specific surveys. The activity of each nest will also be determined during site-specific surveys. Alternative B would result in slightly more impacts to the golden eagle than would occur under the No Action Alternative. Compared to the No Action Alternative, development under Alternative B would result in the disturbance of 366 more acres of nest buffer area. However, the disturbance of this nest buffer area is negligible due to applicant-committed measures.

Golden Eagle Determination (Alternative B)

Implementation of Alternative B may affect individuals, but is **not likely to contribute to the need to become listed**.

Rationale for Golden Eagle Determination (Alternative B)

Although 507 acres within 0.5 mile of known golden eagle nests would be directly impacted by Alternative B surface disturbance; this constitutes a small percentage of suitable habitat available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat and eliminate direct impacts to individual birds during the nesting season. While Alternative B could potentially result in direct and indirect adverse impacts to golden eagles, the probability is relatively low based on number of nests and nest buffer area that could be disturbed during the life of the project.

4.12.1.2.2.11 Short-eared Owl

Impacts to the short-eared owl under Alternative B would be of the same nature as under the Proposed Action, but would affect fewer acres within the owl's potential habitat. Under the Proposed Action, approximately 4,329 acres of well pads, roads, and other facilities would be constructed in short-eared owl potential habitat, rendering 3.0% of this area unsuitable to owls for the life of the project (see Table 4-118). Alternative B would result in greater adverse impacts to the short-eared owl than would occur under the No Action Alternative. Compared to the No Action Alternative, development under Alternative B would result in the disturbance of 2,628 more acres of the short-eared owl's habitat.

Short-eared Owl Determination (Alternative B)

Implementation of Alternative B may affect individuals, but is **not likely to contribute to the need to become listed.**

Rationale for Short-eared Owl Determination (Alternative B)

Although 4,329 acres surface disturbance of potential short-eared owl habitat would be directly impacted by Alternative B, this constitutes a small percentage of such habitats available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat and eliminate direct impacts to individual birds during the nesting season. While Alternative B could potentially result in direct and indirect adverse impacts to short-eared owls, the probability is relatively low based on the percentage of habitat that would be disturbed during the life of the project.

4.12.1.2.2.12 Lewis' Woodpecker

Impacts to the Lewis' woodpecker would be of the same nature as those described under the Proposed Action. Surface-disturbing activities under Alternative B would impact 996 acres of Lewis' woodpecker habitat (see Table 4-119). Alternative B would result in somewhat greater impacts to Lewis' woodpecker than would occur under the No Action Alternative. Compared to the No Action Alternative, development under Alternative B would result in the disturbance of 709 more acres of habitat.

Lewis' Woodpecker Determination (Alternative B)

Implementation of Alternative B may affect individuals, but is **not likely to contribute to the need to become listed.**

Rationale for Lewis' Woodpecker Determination (Alternative B)

Although 996 acres surface disturbance of potential Lewis' woodpecker habitat would be directly impacted by Alternative B, this constitutes a small percentage of such habitats available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat and eliminate direct impacts to individual birds during the nesting season. While Alternative B could potentially result in direct and indirect adverse impacts to Lewis' woodpecker, the probability is relatively low based on the percentage of habitat that would be disturbed during the life of the project.

4.12.1.2.2.13 Mountain Plover

The nature of the impacts to the mountain plover would be similar to those described under the Proposed Action. Surface-disturbing activities under Alternative B would impact 487 acres of mountain plover known breeding habitat (2.2%). Alternative B would result in somewhat lesser impacts to mountain plover known breeding habitat than would occur under the No Action Alternative. Compared to the No Action Alternative, development under Alternative B would result in the disturbance of 12 fewer acres of known breeding habitat (see Table 4-120).

Mountain Plover Determination (Alternative B)

Implementation of Alternative B may impact individuals, but is **not likely to contribute to the need to become listed**.

Rationale for Mountain Plover (Alternative B)

Although 487 acres of surface disturbance of potential mountain plover habitat would be directly impacted by Alternative B, this constitutes a small percentage of such habitats available both within the project area and throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat, and eliminate direct impacts to individual birds during the nesting season.

4.12.1.2.2.14 Sensitive Fish Species

Impacts to roundtail chub, bluehead sucker, and flannelmouth sucker would be the same as the impacts to federally listed Colorado River fish, as described in Section 4.12.1.1.1.11.

Colorado River Sensitive Fish Determinations (Alternative B)

Implementation of Alternative B may affect individuals, but is **not likely to contribute to the need to become listed.**

Colorado River Sensitive Fish Determination Rational (Alternative B)

The rationale for the determination above is the same as described for the Proposed Action. In addition, adverse impacts would be somewhat fewer under Alternative B, as described above.

4.12.1.2.3 Other Special Status Species Retained for Analysis

4.12.1.2.3.1 Raptors

Under Alternative B, 1,348 acres of surface disturbance would occur within 0.5 mile of raptor nests. This represents approximately 3.6% of the total raptor nest buffers in the project area. Approximately 3 times more surface disturbance would occur in these areas under Alternative B than under the No Action Alternative, where 417 acres of disturbance would occur, representing 1.1% of the total (see Table 4-122).

Under Alternative B, 68 miles of new roads would be built; 4.5 times more miles of new roads than under the No Action Alternative and a 51% increase over existing conditions (see Table 4-122).

Raptor Determination (Alternative B)

Implementation of Alternative B may affect individuals, but is **not likely to contribute to the need to become listed.**

Rationale for Raptor Determination (Alternative B)

Although 1,348 acres surface disturbance would occur within 0.5 mile of raptor nests under Alternative B, this constitutes a small percentage of such habitats available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat and eliminate direct impacts to individual birds during the nesting season. While Alternative B could potentially result in direct and indirect adverse impacts to raptor nesting habitat, the probability is relatively low based on the percentage of habitat that could be disturbed during the life of the project.

4.12.1.2.3.2 Migratory Birds

Under Alternative B, 5,685 acres (approximately 2.8%) of potential migratory bird habitat would be converted to well pads, roads, and evaporative facilities. This is approximately 3 times more migratory bird habitat converted to well pads, roads, and evaporative facilities than would be converted under the No Action Alternative (see Table 4-123). More than half of the habitat loss under Alternative B would occur in scrub/shrub habitat types (3,494 acres or approximately 3% of scrub/shrub habitat types across the project area). The majority of surface disturbance under the No Action Alternative would also occur in scrub/shrub habitat types, but this disturbance would be 59% lower than under Alternative B. Surface disturbance would also occur in evergreen forest (821 acres), barren lands (506 acres), grasslands/herbaceous (523 acres), woody wetland and open water (213 acres, including 188 acres of greasewood vegetation), and disturbed and agricultural land (128 acres) under Alternative B. Under Alternative B, surface disturbance in these habitat types would be 56%–77% more than under No Action (see Table 4-124).

Under Alternative B, road-related impacts to migratory birds would result from the construction of 274 miles (a 49% increase over current conditions) of new roads in migratory bird habitat. This would be approximately 4 times the miles of new roads as under the No Action Alternative, where 72 miles of new roads (a 13% increase over current conditions) would be constructed. Under Alternative B, there would be an estimated 4.8% maximum increase in traffic volume over current conditions (see Section 4.5, Table 4-75). The construction of new roads would also have indirect impacts associated with habitat fragmentation (discussed in detail in Section 4.16.1.2.6) and noise disturbances.

Under Alternative B, 74% (153,777 acres) of the total migratory bird habitat in the project area would lose functional value due to habitat fragmentation. This is approximately 13% more unfavorable habitat than would occur under the No Action Alternative (see Table 4-124), and 27% more than under current conditions. Migratory birds that use the scrub/shrub habitat type would be most heavily impacted because more than half of the total habitat fragmentation would occur in this vegetation type under Alternative B and the No Action Alternative. However, impacts would be less severe under the No Action Alternative, because approximately 8% less habitat fragmentation would occur than under Alternative B (see Table 4-124).

Migratory Birds Determination (Alternative B)

Implementation of Alternative B may affect individual migratory birds, but is **not likely to contribute to the need to become listed**.

Rationale for Migratory Birds Determination (Alternative B)

None of the migratory birds considered are proposed for listing under the ESA or included on the BLM sensitive species list. Although impacts in the project area could adversely affect local populations or individuals, a relatively small percentage of each species' habitat within their entire range would be impacted by the Proposed Action. In addition, no more than 4% of each species' habitat in the project area would be directly impacted (Table 4-123) under Alternative B. Based on this analysis, the BLM has determined that Alternative B would not contribute to the need for federal listing of any of these migratory bird species.

4.12.1.3 Alternative C: Full Development

4.12.1.3.1 Federally Listed Threatened, Endangered, and Candidate Species

4.12.1.3.1.1 Impacts Common to Several Species

These would be of the same nature as described for the Proposed Action (see Section 4.12.1.1.1.1).

4.12.1.3.1.2 Clay Reed-mustard

Impacts to clay reed-mustard under Alternative C would be the same as under the Proposed Action; no occupied or suitable clay reed-mustard habitat areas would be disturbed (see Map 37).

Clay Reed-mustard Determination (Alternative C)

The implementation of Alternative C **may affect, but is not likely to adversely affect** the species.

Rationale for Clay Reed-mustard Determination (Alternative C)

The rationale for this determination under Alternative C is the same as described for the Proposed Action.

4.12.1.3.1.3 Shrubby Reed-mustard

Impacts to shrubby reed-mustard under Alternative C would be of the same nature as under the Proposed Action, but would affect more acres in the occurrence area for the species (see Map 37). Approximately 26 acres (1.8%) of the Badlands Cliff shrubby reed-mustard habitat area would be disturbed under Alternative C (see Table 4-100). This alternative would result in approximately 26 more acres of disturbance to the Badlands Cliff shrubby reed-mustard habitat area than would occur under the No Action Alternative.

As shown above in Table 4-100, 258 acres of the Badlands Cliff shrubby reed-mustard habitat area occurs within 300 feet of existing and proposed roads. For the purposes of this analysis, this acreage would be at increased risk for the indirect impacts listed under the Proposed Action. This represents 150 more acres than the No Action Alternative.

Shrubby Reed-mustard Determination (Alternative C)

The implementation of Alternative C **may affect, and is likely to adversely affect** the species.

Rationale for Shrubby Reed-mustard Determination (Alternative C)

The rationale for this determination under Alternative C is the same as described for the Proposed Action.

4.12.1.3.1.4 Pariette Cactus

Impacts to Pariette cactus under Alternative C would be of the same nature as under the Proposed Action, but would directly impact approximately 27 acres of potential Pariette cactus habitats (see Map 37). There would be no impacts to the 2009 core conservation areas, which contain nesting and foraging habitat for the species' insect pollinators. Potential indirect impacts from fugitive dust, invasive weeds, and increased access to habitat areas associated with road development would be greater than under the Proposed Action due to higher density and closer proximity of roads to Pariette cactus habitats. Under Alternative C, there would be 621 acres of potential Pariette cactus habitat and 24 acres of core conservation areas within 300 feet of existing and proposed roads. This is approximately 20 acres more potential habitat than would occur under the No Action Alternative.

Pariette Cactus Determination (Alternative C)

The implementation of Alternative C **may affect, but is not likely to adversely affect,** the species.

Rationale for Pariette Cactus Determination (Alternative C)

The rationale for this determination under Alternative C is the same as described for the Proposed Action, although there would be a slightly greater risk of indirect adverse impacts as described above.

4.12.1.3.1.5 Uinta Basin Hookless Cactus

Impacts to Uinta Basin hookless cactus (*Sclerocactus wetlandicus*) under Alternative C would be of the same nature as under the Proposed Action, but would affect 741 (18%) more acres in the species' potential habitats (see Map 37). Alternative C would result in the direct disturbance of 4,830 acres in potential habitats, totaling 4.9% of the species' habitat in the project area (see Table 4-102). Applicant-committed measures described in Appendix B would minimize the likelihood of direct removal of the species during project construction. Road-associated impacts described under the Proposed Action would occur along approximately 210 miles of new roads in potential habitats under Alternative C. Approximately 30,494 acres of habitat would be within 300 feet of existing and proposed roads, making these habitats more susceptible to the indirect impacts from fugitive dust, sedimentation, and fragmentation and degradation of the cactus' habitat or nesting and foraging habitats for the cactus' insect pollinators. Applicant-committed measures would minimize these risks as described under the Proposed Action. The 4,830 acres of surface disturbance proposed in the cactus's potential habitats under Alternative C has the potential to contain approximately 7,535 plants (see Table 4-102). Including desiccants, up to 9,853 plants may be located in the area proposed for development. In addition, approximately 4,299 spine clusters could be located in areas proposed for development.

This alternative would place 13,085 (75%) more acres in proximity to roads than the No Action Alternative. Overall, development under Alternative C would disturb approximately 3,856 more acres (4 times more) of the Uinta Basin hookless cactus' potential habitat than under the No Action Alternative. It would also result in 116 more miles of road; approximately 2.2 times more road than would be developed under the No Action Alternative.

Uinta Basin Hookless Cactus Determination (Alternative C)

The implementation of Alternative C **may affect, and is likely to adversely affect** the species.

Rationale for Uinta Basin Hookless Cactus Determination (Alternative C)

The rationale for this determination under Alternative C is the same as described for the Proposed Action. In addition, there would be a greater risk of adverse impacts as described above.

4.12.1.3.1.6 Graham's Beardtongue

Impacts to Graham's beardtongue occupied habitat (see Map 37) under Alternative C would be the same as those under the Proposed Action. However, there would be increased potential for indirect impacts to the species from 117 more miles of road development and associated fugitive dust, weed invasion, and impacts to population connectivity and pollinator and seed disperser activity due to habitat fragmentation (see Table 4-104.).

Graham's Beardtongue Determination (Alternative C)

Implementation of Alternative C **is not likely to jeopardize the continued existence of the species, and is not likely to destroy or adversely modify proposed critical habitat.**

Rationale for Graham's Beardtongue Determination (Alternative C)

The rationale for this determination under Alternative C is the same as described for the Proposed Action. In addition, there would be a greater risk of adverse indirect impacts as described above.

4.12.1.3.1.7 Ute Ladies'-tresses

Impacts to the Ute ladies'-tresses under Alternative C would be of the same nature as those under the Proposed Action, but would impact 7 fewer acres (0.32%) of native riparian habitats where the species potentially occurs. Road development would also occur at higher density and in closer proximity to riparian habitats under this alternative. Alternative C would impact 4 more acre of riparian habitat and would result in 454 more miles of road than the No Action Alternative.

Ute Ladies'-tresses Determination (Alternative C)

The implementation of Alternative C **may affect, but is not likely to adversely affect** the species.

Rationale for Ute Ladies'-tresses Determination (Alternative C)

The rationale for this determination under Alternative C is the same as described for the Proposed Action.

4.12.1.3.1.8 Mexican Spotted Owl

Impacts to the MSO under Alternative C would be of the same nature as under the Proposed Action, but would affect more acres of the species' habitat. Approximately 62 acres, or 3.5%, of the MSO habitat classified as “good” in the project area would be disturbed by construction of roads, well pads, and ancillary facilities such as pipelines and evaporative facilities (see Table 4-105). Approximately 6 acres of the MSO habitat classified as “fair” in the project area would be disturbed; and approximately 431 acres, or 2.8%, of the MSO habitat classified as “poor” would be disturbed (see Table 4-105). Alternative C would result in greater impacts to MSOs than under the No Action Alternative due to the disturbance of 62 more acres of “good” habitat. Not only will Alternative C impact the largest amount of MSO habitat compared to all of the other alternatives, but it will also impact the largest amount of acreage (260 acres) within a 0.5-mile buffer surrounding MSO habitat (see Table 4-105). As stated in Section 2.2. 9, all “fair” and “good” habitat below the rim of Nine Mile Canyon will be avoided. Because of this applicant-committed measure, impacts to approximately 52 acres of “good” and 5 acres of “fair” habitat will be avoided under Alternative C. These wells would be re-located during site-specific surveys.

Mexican Spotted Owl Determination (Alternative C)

Implementation of Alternative C **may affect, but is not likely to adversely affect** the species.

Rationale for Mexican Spotted Owl Determination (Alternative C)

Although 62 acres of "good," 6 acres of "fair," and 431 acres of "poor" MSO habitat would be affected by Alternative C, this constitutes a small percentage of "good" habitat available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat, and eliminate direct impacts to individual birds during the nesting season.

4.12.1.3.1.9 Greater Sage-grouse

Impacts to the greater sage-grouse under Alternative C would be the same as under the Proposed Action, but would affect 368 fewer acres within 2 miles of known leks, 900 more acres of brooding habitat, and 373 fewer acres of wintering habitat. Under Alternative C, approximately 473 acres of surface disturbance by well pads, roads, evaporation facilities, and pipeline corridors would occur within the 2-mile buffer around the known greater sage-grouse lek (see Table 4-106). This would comprise 5.9% of the 8,032 acres within the buffer zone. Approximately 3,948 acres of surface disturbance would occur within the 84,647 acres of UDWR-designated brooding habitat, constituting a conversion of 4.7% of total available acres in the project area. Roads proposed under Alternative C would contribute to the devaluation or degradation of 95.9% of the 84,647 acres of potential sage-grouse habitat in the project area. Approximately 1,894 acres of surface disturbance would occur within the 38,747 acres of UDWR-designated wintering habitat, constituting a conversion of 4.9% of total available acres in the project area.

Alternative C would result in more adverse impacts to the greater sage-grouse than would occur under the No Action Alternative. Compared to the No Action Alternative, development under Alternative C would impact 426 more acres within lek buffers, resulting in the disturbance of 3,085 more acres of potential breeding habitat and 1,698 more acres of potential wintering habitat, and fragment 22,344 more acres of potential brooding habitat.

Greater Sage-grouse Determination (Alternative C)

Implementation of Alternative C may impact and could lead to a downward population trend, but **would not likely contribute to the listing of the species.**

Rationale for Greater Sage-grouse Determination (Alternative C)

Although 473 acres within 2 miles of a known (inactive) lek, 3,948 acres of potential brooding habitat and 1,894 acres of potential wintering habitat would be directly impacted by Alternative C, this constitutes a small percentage of such habitats available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat and eliminate direct impacts to individual birds during the nesting season.

4.12.1.3.1.10 Western Yellow-billed Cuckoo

Impacts to the WYBC under Alternative C would be of the same nature as those under the Proposed Action, but would affect fewer acres of the species' habitat. Under Alternative C, 20 fewer acres of potential habitat (riparian vegetation) are anticipated to be impacted than would be impacted under the Proposed Action with a total of 0.7% of the total suitable riparian habitat in the project area impacted (Table 4-107). Depending on the location of the impacts along the riparian areas in the project area, the impacts could be more or less severe.

Adverse impacts to the species would be mitigated by restricting new surface-disturbing activities within 330 feet of riparian areas. In wet meadows, springs, and seeps, surveys to assess riparian habitat on a case-by-case basis would take place prior to the initiation of any construction activities. If the species or habitat for the WYBC is found, then the area would be avoided if possible.

Western Yellow-billed Cuckoo Determination (Alternative C)

Implementation of Alternative C may impact and could lead to a downward population trend, but **would not likely contribute to the listing of the species**.

Rationale for Western Yellow-billed Cuckoo Determination (Alternative C)

Although 9 acres of suitable WYBC habitat would be directly impacted by Alternative C, this constitutes a small percentage of suitable habitat available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat and eliminate direct impacts to individual birds during the nesting season.

4.12.1.3.1.11 Threatened, Endangered, and Candidate Fish Species

Impacts to Colorado River fish under Alternative C would be of the same nature as those under the Proposed Action, but would generally result in impacts of greater magnitude, including more depletion of the Green River and more disturbance of erosive soils, but a slightly lower risk of a pipeline spill. Under Alternative C, approximately 1,253 pipeline crossings of intermittent/ephemeral drainages that are tributary to the Green River would be required (see Table 4-108). A total of four wells are proposed within the 100-year floodplain for the Green River, as well as 0.8 mile of roads and pipelines. An additional 34 wells are proposed within 100-year floodplains of Green River tributaries within 5 miles of the river, along with 25 miles of pipeline.

The risk of acute or chronic toxicity to endangered fish in the Green River in the event of a natural-gas condensate spill would be the same as that under the Proposed Action, although the likelihood of a spill would be lessened. The 1.88 mile of pipeline in the Green River floodplain under Alternative C would carry a risk of 0.055 incident over the 30-year production phase, or one incident every 543 years. The 24.7 miles of pipeline crossing floodplains within 5 miles of the Green River would carry a risk of 0.74 incident over the 30-year production phase over which each pipeline would be used, or 1 incident every 40 years. However, spill attenuation would greatly reduce the risk of a spill reaching the Green River before it evaporated.

Under Alternative C, approximately 365 acre-feet of water from the Green River Basin would be consumed over the lifetime of the project (see Table 4-129). Peak annual withdrawals from sources that feed the Green River would be the same as under the Proposed Action (approximately 23 acre-feet per year; see Table 4-129). This equates to approximately 0.04 cfs of withdrawal and would represent a loss of approximately 0.005% of the approximately 1,000 cfs recorded minimum stream flow of the Green River adjacent to the project area. This flow reduction would be considered a long-term (life of the project) impact in terms of reductions in habitat for listed fish species in the Green River. Approximately 37 acres of highly erosive soils would be disturbed (Table 4-93). Project-related disturbance would increase the Green River's sediment load by approximately 136,581 tons, or 0.04% (see Table 4-131, Section 4.15).

Alternative C would result in greater adverse impacts to Colorado River fish than would occur under the No Action Alternative. Compared to the No Action Alternative, development under Alternative C would consume 294 more acre-feet of water from the Green River Basin, result in the disturbance of 27 more acres of water-erosive soils, and require 780 more intermittent/ephemeral stream crossings by pipelines. Alternative C would result in the same number of wells (but 0.2 more mile of pipeline) in the Green River floodplain, and 28 more wells (with 17.2 more miles of pipeline) crossing floodplains within 5 miles of the Green River.

Colorado River Endangered Fish Determinations (Alternative C)

Implementation of Alternative C **may affect, and is likely to adversely affect** these species.

Colorado River Endangered Fish Determination Rational (Alternative C)

The rationale for the determination above is the same as described for the Proposed Action.

4.12.1.3.2 State of Utah and BLM Sensitive Species

4.12.1.3.2.1 Untermann Daisy

Impacts to the Untermann daisy under Alternative C would be of the same nature as those under the Proposed Action, but would affect 397 more acres of potential habitat (see Map 37). Development under Alternative C would disturb 2,174 acres of potential Untermann daisy habitat, or 4.7% of its potential habitat in the project area (see Table 4-109). Potential indirect impacts to the species would be increased due to 117 more miles of road development and associated fugitive dust, weed invasion, and impacts to population connectivity and pollinator activity from habitat fragmentation. Approximately 14,566.1 acres of Untermann daisy habitat would be effectively placed within 300 feet of existing and proposed roads under this alternative, 7,014 more acres than the No Action Alternative. For the purposes of this analysis, this habitat would be more susceptible to the indirect effects of roads. Overall, Alternative C would result in greater adverse impacts to the Untermann daisy than would occur under the No Action Alternative due to the disturbance of 1,893 more acres of the daisy's habitat.

Untermann Daisy Determination (Alternative C)

Implementation of Alternative C may affect individuals, but is **not likely to contribute to the need to become listed.**

Rationale for Untermann Daisy Determination (Alternative C)

The rationale for this determination under Alternative C is the same as described for the Proposed Action. In addition, there would be a greater risk of adverse impacts,as described above.

4.12.1.3.2.2 Sterile Yucca

Impacts to sterile yucca under Alternative C would be of the same nature as those under the Proposed Action, but would directly affect 0.06 fewer acres (7.1%) and indirectly affect 1.1 fewer acres of known sterile yucca habitat than under the Proposed Action (see Table 4-110; Map 37).

Sterile Yucca Determination (Alternative C)

Implementation of Alternative C may affect individuals, but is **not likely to contribute to the need to become listed**.

Rationale for Sterile Yucca Determination (Alternative C)

Because direct impacts to the sterile yucca's habitat would total less than than 2% of the known habitat available in the project area, and because considerable additional habitat exists beyond the project area, project-related activities are not likely to contribute to the need for federal listing of the species. In addition, site-specific avoidance and minimization measures, where required by the AO, would further reduce direct or indirect impacts to sterile yucca individuals and habitats.

4.12.1.3.2.3 Graham's Catseye, Barneby's Catseye, Goodrich's Blazingstar, Goodrich's Columbine, and Uinta Greenthread

Because the acreages of the potential habitats for these five species have not been mapped or determined for the project area, impacts are broadly described and compared between the action alternatives. In general, direct and indirect impacts to these five plant species under Alternative C would be comparable to the nature and degree of direct impacts described for other State of Utah and BLM sensitive plant species associated with similar Green River shale habitats, which would be the same as under the Proposed Action. Indirect impacts to these species' habitats would be greater than under the Proposed Action and No Action alternatives due to 201 miles and 454 additional miles of road development, respectively.

Graham's catseye, Barneby's catseye, Goodrich's blazingstar, Goodrich's columbine, and Uinta greenthread Determination (Alternative C)

Implementation of Alternative C may affect individuals, but is **not likely to contribute to the need for listing for any of the five species**.

Rationale for Graham's catseye, Barneby's catseye, Goodrich's blazingstar, Goodrich's columbine, and Uinta greenthread Determination (Alternative C)

Because additional habitats for Graham's catseye, Barneby's catseye, Goodrich's blazingstar, Goodrich's columbine, and Uinta greenthread exist beyond the project area, and because site-specific avoidance and minimization measures, where required by the AO, would further reduce direct or indirect impacts to individuals and habitats, project-related activities are not likely to contribute to the need for federal listing of these species.

4.12.1.3.2.4 White-tailed Prairie Dog

Impacts to the white-tailed prairie dog under Alternative C would be of the same nature as under the Proposed Action, but would affect more acres of known colonies. Surface-disturbing activities associated with the Proposed Action (e.g., the construction of well pads, pipelines, and access roads) would result in the loss of approximately 982 discontinuous acres of prairie dog colonies in the project area, or 6.3% of the colonies present (see Table 4-111). Alternative C would result in greater adverse impacts to the white-tailed prairie dog than would occur under the No Action Alternative. Compared to the No Action Alternative, development under Alternative C would result in the disturbance of 645 more acres of the prairie dog's habitat.

White-tailed Prairie Dog Determination (Alternative C)

Implementation of Alternative C may affect individuals, but is not **likely to contribute to the need to become listed.**

Rationale for White-tailed Prairie Dog Determination (Alternative C)

The rationale for this determination under Alternative C is the same as described for the Proposed Action. However, the amount of habitat impacted by this alternative is greater than the Proposed Action, and would have impacts on the largest amount of acreages of prairie dog habitat compared to any of the alternatives considered.

4.12.1.3.2.5 Big Free-tailed Bat

Impacts to the big free-tailed bat would be of the same nature as those described under the Proposed Action. Surface-disturbing activities under Alternative C would impact 163 acres of potential roosting habitat, and 6,794 acres of potential foraging habitat. Alternative C would result in considerably greater impacts to the big free-tailed bat than would occur under the No Action Alternative. Compared to the No Action Alternative, development under Alternative C would result in the disturbance of 132 more roosting acres and 5,253 more foraging acres of big free-tailed bat potential habitat (see Table 4-112).

Big Free-tailed Bat Determination (Alternative C)

Implementation of Alternative C may affect individuals, but is **not likely to contribute to the need to become listed.**

Rationale for Big Free-tailed Bat Determination (Alternative C)

The rationale for this determination under Alternative C is the same as described for the Proposed Action. In addition, there would be a greater risk of adverse indirect impacts, as described above.

4.12.1.3.2.6 Spotted Bat

Impacts to the spotted bat would be of the same nature as those described under the Proposed Action. Surface-disturbing activities under Alternative C would impact 163 acres of potential roosting habitat, and 9,383 acres of potential foraging habitat. Alternative C would result in considerably greater impacts to the spotted bat than would occur under the No Action Alternative. Compared to the No Action Alternative, development under Alternative C would result in the disturbance of 132 more roosting acres and 7,450 more foraging acres of spotted bat potential habitat (see Table 4-113).

Spotted Bat Determination (Alternative C)

Implementation of Alternative C may affect individuals, but is **not likely to contribute to the need to become listed.**

Rationale for Spotted Bat Determination (Alternative C)

The rationale for this determination under Alternative C is the same as described for the Proposed Action. In addition, there would be a greater risk of adverse indirect impacts, as described above.

4.12.1.3.2.7 Burrowing Owl

Impacts to the burrowing owl under Alternative C would be of the same nature as under the Proposed Action, but would affect 41% fewer acres within 0.5 mile of known owl nests. Under Alternative C, 63 acres (4.1%) within the 0.4-mile nest buffer areas would be directly converted to well pads, roads, and other facilities (see Table 4-114). In addition, surface-disturbing activities under Alternative C (e.g., the construction of well pads, pipelines, and access roads) would result in the loss of approximately 982 acres of prairie dog/burrowing owl habitat in the project area (see Table 4-111). Alternative C would result in greater adverse impacts to the burrowing owl than would occur under the No Action Alternative. Compared to the No Action Alternative, development under Alternative C would result in the disturbance of 49 more acres of the owl's habitat (see Table 4-114).

Burrowing Owl Determination (Alternative C)

Implementation of Alternative C may affect individuals, but is **not likely to contribute to the need to become listed.**

Rationale for Burrowing Owl Determination (Alternative C)

Although 63 acres of burrowing owl nesting habitat and 982 acres of prairie dog/burrowing owl habitat would be directly impacted by Alternative C, this constitutes a small percentage of suitable habitat available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat, and eliminate direct impacts to individual birds during the nesting season. While Alternative C would result in direct and indirect adverse impacts to burrowing owls, the probability is relatively low based on the percentage of habitat that could be disturbed during the life of the project.

4.12.1.3.2.8 Ferruginous Hawk

Impacts to the ferruginous hawk under Alternative C would be of the same nature as under the Proposed Action, but would affect more acres within 0.5 mile of known hawk nests. Under Alternative C, 677 acres (4.9%) within the 0.5-mile buffer around ferruginous hawk nesting areas would be directly converted to well pads, roads, or other facilities (see Table 4-115). In addition, the construction of well pads and roads would effectively remove 7,534 acres (or 5.1%) of potential foraging habitat from use by ferruginous hawks. Alternative C would result in greater adverse impacts to the ferruginous hawk than would occur under the No Action Alternative. Compared to the No Action Alternative, development under Alternative C would result in the disturbance of 505 more acres of the ferruginous hawk's nest buffers and 5,833 more acres of the hawk's potential foraging habitat (see Table 4-115).

Determination for Ferruginous Hawk (Alternative C)

Implementation of Alternative C may affect individuals, but is **not likely to contribute to the need to become listed.**

Rationale for Ferruginous Hawk Determination (Alternative C)

Although 7,534 acres of foraging habitat and 677 acres of nesting habitat would be directly impacted by Alternative C, this constitutes a small percentage of suitable habitat available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat and eliminate direct impacts to individual birds during the nesting season.

4.12.1.3.2.9 Bald Eagle

Impacts to bald eagles under Alternative C would be of the same nature as those under the Proposed Action, but would affect fewer acres of the species' roosting habitat. Impacts to wintering bald eagles would include the long-term surface disturbance, fragmentation, and human-disturbance of approximately 68 acres of winter roosting habitat within 0.5 mile of known winter roosting areas. This is approximately 1.6% of the bald eagle winter roosting habitat in the project area that would be disturbed by construction of roads, well pads, and ancillary facilities such as pipelines (see Table 4-116). In addition, approximately 4 acres (0.3%) of all potential roosting habitat (riparian) in the project area would be disturbed. Road-associated impacts described under the Proposed Action would occur along approximately 526 miles of new roads within the project area under Alternative C, 129 more miles than under the Proposed Action. Alternative C would result in the disturbance of 18 more acres within 0.5 mile of known roosting sites, 4 more acres of potential roosting habitat, and 454 more miles of road than under the No Action Alternative.

Bald Eagle Determination (Alternative C)

Implementation of Alternative C **may** affect individuals**, but is not likely to contribute to the need to become listed.**

Rationale for Bald Eagle Determination (Alternative C)

Although 68 acres of bald eagle winter roosting habitat within 0.5 mile of known winter roosting areas, and 4 acres of potential winter roosting habitat would be directly impacted by Alternative C, this constitutes a small percentage of suitable habitat available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat, and eliminate direct impacts to individual birds during the nesting season. While Alternative C could potentially result in direct and indirect adverse impacts to the bald eagle, the probability is relatively low based on the percentage of habitat that could be disturbed during the life of the project.

4.12.1.3.2.10 Golden Eagle

Short- and long-term direct and indirect impacts of well development on golden eagles are identical to those described in Section 4.12.1.1.3.1, Raptors. All applicant-committed measures will be followed as stated in Section 2.2.9.6.

Surface-disturbing activities under Alternative C would impact 558 acres of nest buffer area (see Table 4-117). Temporal and spatial buffers apply to nests, and will be prescribed during site-specific surveys. The activity of the nest will also be determined during site-specific surveys. Alternative C would result in slightly more impacts to the golden eagle than would occur under the No Action Alternative. Compared to the No Action Alternative, development under Alternative C would result in the disturbance of 417 more acres of nest buffer area. However, the disturbance of these areas would be negligible due to applicant-committed measures and BMPs.

Golden Eagle Determination (Alternative C)

Implementation of Alternative C may affect individuals, but is **not likely to contribute to the need to become listed.**

Rationale for Golden Eagle Determination (Alternative C)

Although 558 acres of surface disturbance within 0.5 mile of known golden eagle nests would be directly impacted by Alternative C, this constitutes a small percentage of suitable habitat available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat and eliminate direct impacts to individual birds during the nesting season. While Alternative C could potentially result in direct and indirect adverse impacts to golden eagles, the probability is relatively low based on the number of nests that could be disturbed during the life of the project.

4.12.1.3.2.11 Short-eared Owl

Impacts to the short-eared owl under Alternative C would be of the same nature as those under the Proposed Action, but would affect more acres within the owl's potential habitat. Under the Proposed Action, approximately 7,534 acres of well pads and roads would be constructed in short-eared owl potential habitat, rendering 5.1% of this area inaccessible to owls for the life of the project (see Table 4-118).

Short-eared Owl Determination (Alternative C)

Implementation of Alternative C may affect individuals, but is **not likely to contribute to the need to become listed.**

Rationale for Short-eared Owl Determination (Alternative C)

Although 7,534 acres surface disturbance of potential short-eared owl habitat would be directly impacted by Alternative C, this constitutes a small percentage of such habitats available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat and eliminate direct impacts to individual birds during the nesting season. While Alternative C could potentially result in direct and indirect adverse impacts to short-eared owls, the probability is relatively low based on the percentage of habitat that could be disturbed during the life of the project.

4.12.1.3.2.12 Lewis' Woodpecker

Impacts to the Lewis' woodpecker would be of the same nature as those described under the Proposed Action. Surface-disturbing activities under Alternative C would impact 1,740 acres of Lewis' woodpecker habitat (4.2%). Alternative C would result in greater impacts to Lewis' woodpecker than would occur under the No Action Alternative. Compared to the No Action Alternative, development under Alternative C would result in the disturbance of 1,453 more acres of habitat (see Table 4-119).

Lewis' Woodpecker Determination (Alternative C)

Implementation of Alternative C may affect individuals, but is **not likely to contribute to the need to become listed.**

Rationale for Lewis' Woodpecker Determination (Alternative C)

Although 1,740 acres surface disturbance of potential Lewis' woodpecker habitat would be directly impacted by Alternative C, this constitutes a small percentage of such habitats available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat and eliminate direct impacts to individual birds during the nesting season. While the Alternative C could potentially result in direct and indirect adverse impacts to Lewis' woodpecker, the probability is relatively low based on the percentage of habitat that could be disturbed during the life of the project.

4.12.1.3.2.13 Mountain Plover

Impacts to the mountain plover would be similar to those described under the Proposed Action. Surface-disturbing activities under Alternative C would impact 1,326 acres of mountain plover known breeding habitat (5.8%). Alternative C would result in greater impacts to mountain plover known breeding habitat than would occur under the No Action Alternative. Compared to the No Action Alternative, development under Alternative C would result in the disturbance of 827 more acres of known breeding habitat (see Table 4-120).

Mountain Plover Determination (Alternative C)

Implementation of Alternative C may impact individuals, but is **not likely to contribute to the need to become listed**.

Rationale for Mountain Plover (Alternative C)

Although 1,326 acres of surface disturbance of potential mountain plover habitat would be directly impacted by Alternative C, this constitutes a small percentage of such habitats available both within the project area and throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat, and eliminate direct impacts to individual birds during the nesting season.

4.12.1.3.2.14 Sensitive Fish Species

Impacts to roundtail chub, bluehead sucker, and flannelmouth sucker would be the same as the impacts to federally listed Colorado River fish.

Colorado River Sensitive Fish Determinations (Alternative C)

Implementation of Alternative C may affect individuals, but is **not likely to contribute to the need to become listed.**

Colorado River Sensitive Fish Determination Rational (Alternative C)

The rationale for the determination above is the same as described for the Proposed Action.

4.12.1.3.3 OTHER SPECIAL STATUS SPECIES RETAINED FOR ANALYSIS

4.12.1.3.3.1 Raptors

Under Alternative C, 1,711 acres of surface disturbance would occur within 0.5-mile of raptor nests. This represents 4.5% of the total area with 0.5-mile of all raptor nests. Approximately 4 times more surface disturbance would occur in these areas under Alternative C than under the No Action Alternative (see Table 4-122).

Under Alternative C, 90 miles of new roads would be built within a 0.5-mile radius of raptor nests, which is 6 times more miles of new roads than under the No Action Alternative (see Table 4-122), and 68% more than under current conditions.

Raptor Determination (Alternative C)

Implementation of Alternative C may affect individuals, but is **not likely to contribute to the need to become listed.**

Rationale for Raptor Determination (Alternative C)

Although 1,711 acres surface disturbance would occur within 0.5-mile of raptor nests under Alternative C, this constitutes a small percentage of these habitats available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat and eliminate direct impacts to individual birds during the nesting season. While Alternative C could potentially result in direct and indirect, adverse impacts to raptor nesting habitat, the probability is relatively low based on the percentage of habitat that could be disturbed during the life of the project.

4.12.1.3.3.2 Migratory Birds

Under Alternative C, 9,979 acres (4.8%) of potential migratory bird habitat would be converted to well pads, roads, and evaporative facilities, nearly 5 times the amount under the No Action Alternative (see Table 4-123). More than half of the habitat loss under Alternative C would occur in scrub/shrub habitat types (6,224 acres or 5.2% of scrub/shrub habitat types across the project area). The majority of surface disturbance under the No Action Alternative would also occur in scrub/shrub habitat types, but this disturbance would be 77% lower than under Alternative C. Surface disturbance would also occur in evergreen forest (1,332 acres), barren lands (1,090 acres), grasslands/herbaceous (730 acres), woody wetland and open water (351 acres), and disturbed and agricultural land (252 acres) under Alternative C. Surface disturbance in these habitat types would be 73%–86% more under Alternative C than under the No Action Alternative (see Table 4-123).

Under Alternative C, road-related impacts to migratory birds would result from the construction of 526 miles of new roads in migratory bird habitat, more than 7 times more miles of new roads than under the No Action Alternative, and 94% more than under current conditions. Under Alternative C, there would be an estimated 8.5% maximum increase in traffic volume over current conditions (see Section 4.5, Table 4-75). The construction of new roads would also have indirect impacts associated with habitat fragmentation (discussed in detail in Section 4.16.1.3.6) and noise disturbances.

Under Alternative C, 194,089 acres (94%) of the total migratory bird habitat in the project area would lose functional value due to habitat fragmentation. This is approximately 43% more unfavorable habitat than would occur under the No Action Alternative (see Table 4-124), and 60% more than under current conditions. Migratory birds that use the scrub/shrub habitat type would be most heavily impacted because more than half of the total habitat fragmentation would occur in this vegetation type under Alternative C and the No Action Alternative. However, impacts would be less severe under the No Action Alternative because approximately 27% less habitat fragmentation would occur than under Alternative C in the scrub/shrub habitat type (see Table 4-124).

Migratory Birds Determination (Alternative C)

Alternative C may affect individuals, but is **not likely to contribute to the need to become listed**.

Rationale for Migratory Birds Determination (Alternative C)

None of the migratory birds considered are proposed for listing under the ESA or included on the BLM sensitive species list. Although impacts in the project area could adversely affect local populations or individuals, a relatively small percentage of each species' habitat within their entire range would be impacted by the Proposed Action. In addition, no more than 5.2% of each species' habitat in the project area would be directly impacted (Table 4-123) under Alternative C. Based on this analysis, the BLM has determined that the Alternative C would not contribute to the need for federal listing of any of these migratory bird species.

4.12.1.4 ALTERNATIVE D: NO ACTION

4.12.1.4.1 FEDERALLY LISTED THREATENED, ENDANGERED, AND CANDIDATE SPECIES

4.12.1.4.1.1 Impacts Common to Several Species

These would be of the same nature as described for the Proposed Action (see Section 4.12.1.1.1.1).

4.12.1.4.1.2 Clay Reed-mustard

Impacts to clay reed-mustard under the No Action Alternative would be the same as those under the Proposed Action. No occupied or suitable clay reed-mustard habitat areas would be disturbed (see Map 37).

Clay Reed-mustard Determination (No Action)

Implementation of the No Action Alternative **may affect, but is not likely to adversely affect,** the species.

Rationale for Clay Reed-mustard Determination (No Action)

The rationale for this determination under the No Action Alternative is the same as described for the Proposed Action.

4.12.1.4.1.3 Shrubby Reed-mustard

Impacts to shrubby reed-mustard under the No Action Alternative would be of the same nature as those under the Proposed Action, but would affect far fewer acres of the Badlands Cliff shrubby reed-mustard habitat area (see Map 37). Less than 0.1 acre (0.01%) of the Badlands Cliff shrubby reed-mustard habitat area would be disturbed under the No Action Alternative (see Table 4-100). The No Action Alternative would therefore have the least impact to shrubby reed-mustard of any alternative.

As shown in Table 4-100, 108 acres (7.5%) of the Badlands Cliff shrubby reed-mustard habitat area occurs within 300 feet of existing and proposed roads. For the purposes of this analysis, this acreage would be at increased risk for the indirect impacts listed under the Proposed Action. This represents 163 fewer acres than the Proposed Action.

Shrubby Reed-mustard Determination (No Action)

Implementation of the No Action Alternative **may affect, but is not likely to adversely affect** the species.

Rationale for Shrubby Reed-mustard Determination (No Action)

Surface disturbance would directly affect approximately 0.01% of the Badlands Cliff shrubby reed-mustard habitat area. Applicant-committed measures (Appendix B) would effectively eliminate direct impacts to individual plants or occupied habitat. Indirect impacts would likely occur over 108 acre of the Badlands Cliff shrubby reed-mustard habitat area, and would largely be eliminated by applicant-committed measures.

4.12.1.4.1.4 Pariette Cactus

Impacts to Pariette cactus under the No Action Alternative would be of the same nature as those under the Proposed Action, but would directly impact approximately 6 acres of potential Pariette cactus habitat (see Map 37). Under the No Action Alternative, there would be no direct impacts to the 2009 Pariette cactus core conservation areas, which contain nesting and foraging habitat for the species' insect pollinators. Potential indirect impacts from fugitive dust, invasive weeds, and increased access to habitat areas associated with road development would be considerably reduced compared to the Proposed Action due to an overall reduction in road density, but with 1.5 miles of new roads in potential habitats. Under the No Action Alternative, 602 acres of Pariette cactus habitat and 24 acres of the 2009 core conservation areas occur within 300 feet of existing and proposed roads. Applicant-committed measures and conservation measures would minimize the likelihood of direct disturbance of the species if it is encountered outside of its potential habitats within development areas, but would not eliminate indirect impacts associated with roads, including fugitive dust, weed invasion, and increased access to OHV use and illegal collection.

Pariette Cactus Determination (No Action)

Implementation of the No Action Alternative **may affect, but is not likely to adversely affect** the species.

Rationale for Pariette Cactus Determination (No Action)

The rationale for this determination under the No Action Alternative is the same as described for the Proposed Action.

4.12.1.4.1.5 Uinta Basin Hookless Cactus

Direct impacts to Uinta Basin hookless cactus (*Sclerocactus wetlandicus*) under the No Action Alternative would be of the same nature as those under the Proposed Action, but would affect 9,001 fewer acres of the species' potential habitats (see Map 37). The No Action Alternative would result in the direct disturbance of 974 acres within potential habitats, totaling 1.0% of habitats in the project area (see Table 4-102). Applicant-committed measures and conservation measures would minimize the likelihood of direct removal of the species during project construction, but would not eliminate indirect impacts associated with roads, including fugitive dust, weed invasion, and increased access to OHV use and illegal collection. Road-associated impacts described under the Proposed Action would occur along approximately 99 miles of new roads within potential habitats under the No Action Alternative. Approximately 17,409 acres of habitat would be within 300 feet of existing and proposed roads, making these habitats more susceptible to the indirect impacts from fugitive dust, sedimentation, and fragmentation and degradation of the cactus' habitat or nesting and foraging habitats for the cactus' insect pollinators. Applicant-committed measures would minimize these risks, as described under the Proposed Action. The 820 acres of surface disturbance proposed in the cactus's potential habitats under the No Action Alternative has the potential to contain approximately 1,520 plants (see Table 4-103). Including desiccants, up to 1,987 plants and approximately 867 spine clusters could be located in areas proposed for development under the No Action Alternative.

Uinta Basin Hookless Cactus Determination (No Action)

Implementation of the No Action Alternative **may affect, and is likely to adversely affect** the species.

Rationale for Uinta Basin Hookless Cactus Determination (No Action)

The rationale for this determination under the No Action Alternative is the same as described for the Proposed Action. However, the potential adverse impacts to the species would be considerably fewer than under the Proposed Action, as described above.

4.12.1.4.1.6 Graham's Beardtongue

There would be no direct impacts to occupied Graham's beardtongue habitat under the No Action Alternative (see Table 4-104. ; Map 37). However, there would be potential for indirect impacts to the species from 72 miles of road development in the project area and associated fugitive dust and weed invasion. As under the Proposed Action, approximately 16.2 acres of Graham's beardtongue occupied habitat would be effectively located within 300 feet of existing and proposed roads under this alternative, and therefore at greater risk of indirect adverse impacts such as the invasion of non-native species.

Graham's Beardtongue Determination (No Action)

Implementation of the No Action Alternative **is not likely to jeopardize the continued existence of the species, and is not likely to destroy or adversely modify proposed critical habitat.**

Rationale for Graham's Beardtongue Determination (No Action)

The rationale for this determination under the No Action Alternative is the same as described for the Proposed Action. However, the potential adverse impacts to the species would be considerably fewer than under the Proposed Action, as described above.

4.12.1.4.1.7 Ute Ladies'-tresses

Impacts to the Ute ladies'-tresses under the No Action Alternative would be of the same nature as under the Proposed Action, but would not impact native riparian habitats where the species potentially occurs. Potential indirect impacts to the species would be greatly reduced due to 253 fewer miles of roads and associated fugitive dust, weed invasion, sedimentation, and impacts to pollinators due to habitat fragmentation than under the Proposed Action.

Determination for Ute Ladies'-tresses (No Action)

Implementation of the No Action Alternative **may affect, but is not likely to adversely affect** the species.

Rationale for Ute Ladies'-tresses Determination (No Action)

The rationale for this determination under the No Action Alternative is the same as described for the Proposed Action. However, the potential adverse impacts to the species would be considerably fewer than under the Proposed Action, as described above.

4.12.1.4.1.8 Mexican Spotted Owl (MSO)

Impacts to the MSO under the No Action Alternative would be of the same nature as those under the Proposed Action, but would generally affect fewer acres of the species' habitat. No MSO habitat classified as "good" in the project area would be disturbed by construction of roads, well pads, and ancillary facilities such as pipelines and evaporative facilities (see Table 4-105). Approximately 10 acres (or 2.1%) of the MSO habitat classified as "fair" in the project area would be disturbed, and approximately 16 acres (or 0.1%) of the MSO habitat classified as "poor" would be disturbed (see Table 4-105). Only 5 acres within the 0.5-mile buffer of MSO habitat is expected to be impacted under this alternative (see Table 4-105).

Mexican Spotted Owl Determination (No Action)

Implementation of the No Action Alternative **may affect, but is not likely to adversely affect the species.**

Rationale for Mexican Spotted Owl Determination (No Action)

Although 10 acres of "fair" and 16 acres of "poor" MSO habitat would be affected by the No Action Alternative, this constitutes a small percentage of "good" habitat available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat, and eliminate direct impacts to individual birds during the nesting season.

4.12.1.4.1.9 Greater Sage-grouse

Impacts to the greater sage-grouse under the No Action Alternative would be the same as under the Proposed Action, but would affect 794 fewer acres within 2 miles of known leks, 2,185 fewer acres of brooding habitat, and 2,071 fewer acres of wintering habitat. Under the No Action Alternative, approximately 47 acres of surface disturbance by well pads, roads, evaporation facilities, and pipeline corridors would occur within the 2-mile buffer around the known greater sage-grouse lek (see Table 4-106). This would comprise 0.6% of the 8,032 acres within the buffer zone. Approximately 863 acres of surface disturbance would occur within the 84,647 acres of UDWR-designated brooding habitat, constituting a conversion of 1.0% of total available acres in the project area. Roads proposed under the No Action Alternative (along with existing roads) would contribute to the devaluation or degradation of 69.5% of the 84,647 acres of potential sage-grouse habitat in the project area. Approximately 196 acres of surface disturbance would occur within the 38,747 acres of UDWR-designated wintering habitat, constituting a conversion of 0.5% of total available acres in the project area.

Greater Sage-grouse Determination (No Action)

Implementation of the No Action Alternative may impact and could lead to a downward population trend, but **would not likely contribute to the listing of the species.**

Rationale for Greater Sage-grouse Determination (No Action)

Although 47 acres within 2 miles of a known (inactive) lek, 863 acres of potential brooding habitat, and 196 acres of potential wintering habitat would be directly impacted by the No Action Alternative, this constitutes a small percentage of such habitats available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat and eliminate direct impacts to individual birds during the nesting season. Although the No Action Alternative may result in direct and indirect adverse impacts to greater sage-grouse in the project area, the probability is relatively low based on the percentage of habitat that could be disturbed during the life of the project.

4.12.1.4.1.10 Western Yellow-billed Cuckoo

Impacts to the WYBC under the No Action Alternative would be of the same nature as under the Proposed Action, but would affect fewer acres of the species' habitat. Under the No Action Alternative, 21 fewer acres of potential habitat (riparian vegetation) are anticipated to be impacted than the Proposed Action with a total of 0.7% of the total potential habitat in the project area (Table 4-107). Impacts on this species would be virtually similar under the No Action Alternative as Alternative C, providing both alternatives follow the same regulations for surface-disturbing activities. Depending on the location of the impacts along the riparian areas in the project area, the impacts could be more or less severe.

Adverse impacts to the species would be mitigated by restricting new surface disturbing activities within 330 feet of riparian areas and in wet meadows, springs, and seeps and by surveys to assess riparian habitat on a case-by-case basis takes place prior to the initiation of any construction activities. If the species or habitat for the yellow-billed cuckoo is found, then the area would be avoided if possible.

Western Yellow-billed Cuckoo Determination (No Action)

Implementation of the No Action Alternative may impact and could lead to a downward population trend, but **would not likely contribute to the listing of the species**.

Rationale for Western Yellow-billed Cuckoo Determination (No Action)

Based on this analysis and applicant-committed measures, the BLM has determined that the No Action Alternative may affect, but would not be likely to adversely affect WYBC habitat. This would be due to the avoidance of important riparian areas and site-specific surveys prior to any construction activities being initiated, and the small percentage of riparian habitat that would be impacted under this alternative.

4.12.1.4.1.11 Threatened, Endangered, and Candidate Fish Species

Impacts to Colorado River fish under the No Action Alternative would be of the same nature as those under the Proposed Action, but would result in impacts of lesser magnitude, including less depletion of the Green River, less disturbance of erosive soils, and a slightly lower risk of a pipeline spill. Under the No Action Alternative, approximately 473 pipeline crossings of intermittent/ephemeral drainages that are tributary to the Green River would be required. A total of four wells would be situated within the 100-year floodplain for the Green River, as well as 0.6 mile of roads and pipelines. An additional six wells would lie within 100-year floodplains of Green River tributaries within 5 miles of the river, along with 7.5 miles of pipeline (see Table 4-108).

The risk of acute or chronic toxicity to endangered fish in the Green River in the event of a natural-gas condensate spill would be the same as under the Proposed Action, although the likelihood of a spill would be lower. The 0.6 mile of pipeline in the Green River floodplain under the No Action Alternative would carry a risk of 0.018 incident over their 30-year production phase, or 1 incident every 1,668 years. The 7.5 miles of pipeline crossing floodplains within 5 miles of the Green River would carry a risk of 0.22 incident over the 30-year production phase over which each pipeline would be used, or 1 incident every 133 years. However, spill attenuation would greatly reduce the risk of a spill reaching the Green River before it evaporated.

Under the No Action Alternative, approximately 71 acre-feet of water from the Green River Basin would be consumed over the lifetime of the project (see Table 4-108). Peak annual withdrawals from sources that feed the Green River would be approximately 5 acre-feet per year; see Table 4-108). This equates to approximately 0.011 cfs of withdrawal and would represent a loss of approximately 0.001% of the approximately 1,000 cfs recorded minimum stream flow of the Green River adjacent to the project area. Approximately 10 acres of highly erosive soils would be disturbed (see Table 4-108). Project-related disturbance would increase the Green River's sediment load by approximately 26,636 tons/year, or 0.01% (see Table 4-131 in Section 4.15.1.1.2.2).

Colorado River Endangered Fish Determinations (No Action)

Implementation of the No Action Alternative **may affect, and is likely to adversely affect all Colorado River endangered fish.**

Colorado River Endangered Fish Determination Rational (No Action)

The rationale for the determination above is the same as described for the Proposed Action.

4.12.1.4.2 STATE OF UTAH AND BLM SENSITIVE SPECIES

4.12.1.4.2.1 Untermann Daisy

Impacts to the Untermann daisy under the No Action Alternative would be of the same nature as those under the Proposed Action, but would affect 1,496 (84%) fewer acres of potential habitat (see Map 37). Development under the No Action Alternative would disturb 281 acres of potential Untermann daisy habitat, or 0.6% of its potential habitat in the project area (see Table 4-109). Potential indirect impacts to the species would be considerably reduced due to 325 fewer miles of road development and associated fugitive dust, weed invasion, and impacts to population connectivity and pollinator activity from habitat fragmentation. Approximately 7,552.2 acres of Untermann daisy habitat would be effectively placed within 300 feet of existing and proposed roads under this alternative.

Untermann Daisy Determination (No Action)

Implementation of the No Action Alternative may affect individuals, but is **not likely to contribute to the need to become listed.**

Rationale for Untermann Daisy Determination (No Action)

The rationale for this determination under the No Action Alternative is the same as described for the Proposed Action. However, the potential adverse impacts to the species would be considerably fewer than under the Proposed Action, as described above.

4.12.1.4.2.2 Sterile Yucca

Impacts to sterile yucca under the No Action Alternative would be of the same nature as under the Proposed Action, but would occur on 3.06 acres, which is 36.4% of known sterile yucca habitat in the project area and 2.85 (13.5 times) more acres than under the Proposed Action. Indirect affects to known sterile yucca habitat would be the same as under the Proposed Action.

Sterile Yucca Determination (No Action)

Implementation of the No Action Alternative may affect individuals, but is **not likely to contribute to the need to become listed**.

Rationale for Sterile Yucca Determination (No Action)

Because direct impacts to the sterile yucca's habitat would total less than 2% of the known habitat available in the project area, and because considerable additional habitat exists beyond the project area, project-related activities are not likely to contribute to the need for federal listing of the species. In addition, site-specific avoidance and minimization measures, where required by the AO, would further reduce direct or indirect impacts to sterile yucca individuals and habitats.

4.12.1.4.2.3 Graham's Catseye, Barneby's Catseye, Goodrich's Blazingstar, Goodrich's Columbine, and Uinta Greenthread

Because the acreages of the potential habitats for these five species have not been mapped or determined for the project area, impacts are broadly described and compared between the action alternatives. In general, direct and indirect impacts to these five plant species under Alternative E would be comparable to the nature and degree of direct impacts described for other State of Utah and BLM sensitive plant species associated with similar Green River shale habitats, which are reduced or eliminated compared to the Proposed Action. However, decreased road development under the No Action Alternative would result in fewer indirect impacts to these species habitats due to 253 fewer miles of roads, a 78% reduction compared to the Proposed Action.

Graham's catseye, Barneby's catseye, Goodrich's blazingstar, Goodrich's columbine, and Uinta greenthread Determination (No Action)

Implementation of the No Action Alternative may affect individuals, but is **not likely to contribute to the need for listing for any of the five species**.

Rationale for Graham's catseye, Barneby's catseye, Goodrich's blazingstar, Goodrich's columbine, and Uinta greenthread Determination (No Action)

Because additional habitats for Graham's catseye, Barneby's catseye, Goodrich's blazingstar, Goodrich's columbine, and Uinta greenthread exist beyond the project area, and because site-specific avoidance and minimization measures, where required by the AO, would further reduce direct or indirect impacts to individuals and habitats, project-related activities are not likely to contribute to the need for federal listing of these species.

4.12.1.4.2.4 White-tailed Prairie Dog

Impacts to the white-tailed prairie dog under the No Action Alternative would be of the same nature as those under the Proposed Action, but would affect fewer acres of known colonies. Surface-disturbing activities associated with the Proposed Action (e.g., the construction of well pads, pipelines, and access roads) would result in the loss of approximately 337 discontinuous acres of prairie dog colonies in the project area, or 2.2% of the colonies present (see Table 4-111).

White-tailed Prairie Dog Determination (No Action)

Implementation of the No Action Alternative may affect individuals, but is **not likely to contribute to the need to become listed.**

Rationale for White-tailed Prairie Dog Determination (No Action)

The rationale for this determination under the No Action Alternative is the same as described for the Proposed Action. However, the potential adverse impacts to the species would be considerably fewer than under the Proposed Action, as described above.

4.12.1.4.2.5 Big Free-tailed Bat

Impacts to the big free-tailed bat would be of the same nature as those described under the Proposed Action. Surface-disturbing activities under the No Action Alternative would impact 31 acres of potential roosting habitat (0.8%), and 1,541 acres of potential foraging habitat (1.2%). The No Action Alternative would result in considerably fewer impacts than the Proposed Action, with impacts to 125 fewer acres of potential roosting habitat and 3,904 fewer acres of potential foraging habitat (see Table 4-112).

Big Free-tailed Bat Determination (No Action)

Implementation of the No Action Alternative may affect individuals, but is **not likely to contribute to the need to become listed.**

Rationale for Big Free-tailed Bat Determination (No Action)

The rationale for this determination under the No Action Alternative is the same as described for the Proposed Action. However, the potential adverse impacts to the species would be considerably less than under the Proposed Action, as described above.

4.12.1.4.2.6 Spotted Bat

Impacts to the spotted bat would be of the same nature as those described under the Proposed Action. Surface-disturbing activities under the No Action Alternative would impact 31 acres (0.8%) of potential roosting habitat, and 1,933 acres (1.0%) of potential foraging habitat. The No Action Alternative would result in considerably fewer impacts than the Proposed Action, with impacts to 125 fewer acres of potential roosting habitat and 5,274 fewer acres of potential foraging habitat (see Table 4-113).

Spotted Bat Determination (No Action)

Implementation of the No Action Alternative may affect individuals, but is **not likely to contribute to the need to become listed.**

Rationale for Spotted Bat Determination (No Action)

The rationale for this determination under the No Action Alternative is the same as described for the Proposed Action. However, the potential adverse impacts to the species would be considerably fewer than under the Proposed Action, as described above.

4.12.1.4.2.7 Burrowing Owl

Impacts to the burrowing owl under the No Action Alternative would be of the same nature as those under the Proposed Action, but would affect fewer acres within 0.5 mile of known owl nests. Under the No Action Alternative, 14 acres (0.9%) within 0.5-mile of burrowing owl nests would be directly converted to well pads, roads, and other facilities (see Table 4-114). In addition, surface-disturbing activities under the No Action Alternative (e.g., the construction of well pads, pipelines, and access roads) would result in the loss of approximately 337 acres of prairie dog/burrowing owl habitat in the project area (see Table 4-111).

Burrowing Owl Determination (No Action)

Implementation of the No Action Alternative may affect individuals, but is **not likely to contribute to the need to become listed.**

Rationale for Burrowing Owl Determination (No Action)

Although 14 acres of burrowing owl nesting habitat and 337 acres of prairie dog/burrowing owl habitat would be directly impacted by the No Action Alternative, this constitutes a small percentage of suitable habitat available in the project area and throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat, and eliminate direct impacts to individual birds during the nesting season. Although the No Action Alternative would result in direct and indirect adverse impacts to burrowing owls, the probability is relatively low based on the percentage of habitat that could be disturbed during the life of the project.

4.12.1.4.2.8 Ferruginous Hawk

Impacts to the ferruginous hawk under the No Action Alternative would be of the same nature as those under the Proposed Action, but would affect fewer acres within 0.5 mile of known hawk nests. Under the No Action Alternative, 172 acres (1.2%) within the 0.5-mile buffer around ferruginous hawk nesting areas would be directly impacted by surface disturbance. In addition, the construction of well pads and roads would effectively remove 1,701 acres (or 1.2%) of potential foraging habitat from use by foraging ferruginous hawks (see Table 4-115).

Determination for Ferruginous Hawk (No Action)

Implementation of the No Action Alternative may affect individuals, but is **not likely to contribute to the need to become listed.**

Rationale for Ferruginous Hawk Determination (No Action)

Although 1,701 acres of foraging habitat and 172 acres of nesting habitat would be directly impacted by the No Action Alternative, this constitutes a small percentage of suitable habitat available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat, and eliminate direct impacts to individual birds during the nesting season. While the No Action Alternative could potentially result in direct and indirect adverse impacts to ferruginous hawks, the probability is relatively low based on the percentage of habitat that could be disturbed during the life of the project.

4.12.1.4.2.9 Bald Eagle

Impacts to bald eagles under the No Action Alternative would be of the same nature as those under the Proposed Action, but would affect fewer acres of the species' roosting habitat. Impacts to wintering bald eagles would include the long-term surface disturbance and fragmentation and human-disturbance of approximately 50 acres of winter roosting habitat within 0.5 mile of known winter roosting areas. This is approximately 1.2% of the bald eagle winter roosting habitat in the project area that would be disturbed by construction of roads, well pads, and ancillary facilities such as pipelines (see Table 4-116). In addition, no acres of potential roosting habitat (riparian) in the project area would be disturbed. Road-associated impacts described under the Proposed Action would occur along approximately 72 miles of new roads in the project area under the No Action Alternative.

Bald Eagle Determination (No Action)

Implementation of the No Action Alternative may affect individuals, but is **not likely to contribute to the need to become listed.**

Rationale for Bald Eagle Determination (No Action)

Although 50 acres of bald eagle winter roosting habitat within 0.5 mile of known winter roosting areas would be directly impacted by the No Action Alternative, this constitutes a small percentage of suitable habitat available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat and eliminate direct impacts to individual birds during the nesting season. While the No Action Alternative could potentially result in direct and indirect adverse impacts to bald eagles, the probability is relatively low based on the percentage of habitat that could be disturbed during the life of the project.

4.12.1.4.2.10 Golden Eagle

Short- and long-term direct and indirect impacts of well development on golden eagles are identical to those described in Section 4.12.1.1.3.1, Raptors. All applicant-committed measures will be followed as stated in Section 2.2.9.6.

Surface-disturbing activities under the No Action Alternative would impact 141 acres of nest buffer area (see Table 4-117). Temporal and spatial buffers apply to these nest buffers, and will be prescribed during site-specific surveys. The activity of affected nests would also be determined during site-specific surveys. The No Action Alternative would result in fewer impacts to the golden eagle than the Proposed Action. Compared to the Proposed Action, development under the No Action Alternative would result in the disturbance of 416 fewer acres of nest buffer area. However, the disturbance of this area under the Proposed Action is negligible due to applicant-committed measures.

Golden Eagle Determination (No Action)

Implementation of the No Action Alternative may affect individuals, but is **not likely to contribute to the need to become listed.**

Rationale for Golden Eagle Determination (No Action)

Although 141 acres surface disturbance within 0.5 mile of known golden eagle nests would be directly impacted by the No Action Alternative, this constitutes a small percentage of suitable habitat available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat, and eliminate direct impacts to individual birds during the nesting season. While the No Action Alternative could potentially result in direct and indirect adverse impacts to golden eagles, the probability is relatively low based on the number of nests that could be disturbed during the life of the project.

4.12.1.4.2.11 Short-eared Owl

Impacts to the short-eared owl under the No Action Alternative would be of the same nature as those under the Proposed Action, but would affect fewer acres in the owl's potential habitat. Under the Proposed Action, approximately 1,701 acres of well pads and roads would be constructed in short-eared owl habitat, rendering 1.2% of this area potentially unusable to owls for the life of the project (see Table 4-118).

Short-eared Owl Determination (No Action)

Implementation of the No Action Alternative may affect individuals, but is **not likely to contribute to the need to become listed.**

Rationale for Short-eared Owl Determination (No Action)

Although 1,701 acres surface disturbance of potential short-eared owl habitat would be directly impacted by the No Action Alternative, this constitutes a small percentage of such habitats available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat and eliminate direct impacts to individual birds during the nesting season. While the No Action Alternative could potentially result in direct and indirect adverse impacts to short-eared owls, the probability is relatively low based on the percentage of habitat that could be disturbed during the life of the project.

4.12.1.4.2.12 Lewis' Woodpecker

Impacts to the Lewis' woodpecker would be of the same nature as those described under the Proposed Action. Surface-disturbing activities under the No Action Alternative would impact 287 acres of Lewis' woodpecker habitat. The No Action Alternative would result in fewer impacts to Lewis' woodpecker habitat than would occur under the Proposed Action. Compared to the Proposed Action, development under the No Action Alternative would result in the disturbance of 988 fewer acres of habitat (see Table 4-119).

Lewis' Woodpecker Determination (No Action)

Implementation of the No Action Alternative may affect individuals, but is **not likely to contribute to the need to become listed.**

Rationale for Lewis' Woodpecker Determination (No Action)

Although 287 acres surface disturbance of potential Lewis' woodpecker habitat would be directly impacted by the No Action Alternative, this constitutes a small percentage of such habitats available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat and eliminate direct impacts to individual birds during the nesting season. While the No Action Alternative could potentially result in direct and indirect adverse impacts to Lewis' woodpecker, the probability is relatively low based on the percentage of habitat that could be disturbed during the life of the project.

4.12.1.4.2.13 Mountain Plover

Impacts to the mountain plover would be similar to those described under the Proposed Action. Surface-disturbing activities under the No Action Alternative would impact 499 acres of mountain plover known breeding habitat (2.2%). The No Action Alternative would result in fewer impacts to mountain plover known breeding habitat than would occur under the Proposed Action. Compared to the Proposed Action, development under the No Action Alternative would result in the disturbance of 221 fewer acres of known breeding habitat (see Table 4-120).

Mountain Plover Determination (No Action)

Implementation of the No Action Alternative may impact individuals, but is **not likely to contribute to the need to become listed**.

Rationale for Mountain Plover (No Action)

Although 499 acres of surface disturbance of potential mountain plover habitat would be directly impacted by the No Action Alternative, this constitutes a small percentage of such habitats available both within the project area and throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat, and eliminate direct impacts to individual birds during the nesting season.

4.12.1.4.2.14 Sensitive Fish Species

Impacts to roundtail chub, bluehead sucker, and flannelmouth sucker would be the same as the impacts to federally listed Colorado River fish, as described in Section 4.12.1.4.1.11.

Colorado River Sensitive Fish Determinations (No Action)

Implementation of the No Action Alternative **may affect individuals, but is not likely to contribute to the need to become listed**.

Colorado River Sensitive Fish Determination Rational (No Action)

The rationale for the determination above is the same as described for the Proposed Action.

4.12.1.4.3 OTHER SPECIAL STATUS SPECIES RETAINED FOR ANALYSIS

4.12.1.4.3.1 Raptors

Under the No Action Alternative, 417 acres of surface disturbance would occur within 0.5-mile of raptor nests. This represents 1.1% of the total raptor nesting buffer in the project area (see Table 4-122).

Road-related disturbance to raptors would result from the construction of 15 miles of new roads within 0.5-mile of raptor nests under the No Action Alternative (see Table 4-122). This is a 11% increase over current conditions.

Raptor Determination (No Action)

Implementation of the No Action Alternative may affect individuals, but is **not likely to contribute to the need to become listed**.

Rationale for Raptor Determination (No Action)

Although 417 acres surface disturbance of raptor nesting habitat would be directly impacted by the No Action Alternative, this constitutes a small percentage of such habitats available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat, and eliminate direct impacts to individual birds during the nesting season. While the No Action Alternative could potentially result in direct and indirect adverse impacts to raptor nesting habitat, the probability is relatively low based on the percentage of habitat that could be disturbed during the life of the project.

4.12.1.4.3.2 Migratory Birds

A total of approximately 2,053 acres of surface disturbance would occur on land within migratory bird habitat under the No Action Alternative. This represents approximately 1% of total migratory bird habitat in the project area. The majority of surface disturbance under the No Action Alternative would be in scrub/shrub habitat types (1,428 acres, or 1.2% of total scrub/shrub habitats in the project area), therefore migratory bird species associated with this habitat type would be most heavily impacted. Under the No Action Alternative, surface disturbance would also occur in evergreen forest (190 acres), barren lands (152 acres), grasslands/herbaceous (134 acres), woody wetland and open water (94 acres), and disturbed and agricultural land (55 acres) habitat types (see Table 4-123).

Road-related disturbance to migratory birds would result from the construction of 72 miles of new roads under the No Action Alternative, a 13% increase over current conditions. Under the No Action Alternative, there would be an estimated 1.7% maximum increase in traffic volume over current conditions (see Section 4.5, Table 4-75). The construction of new roads would also have indirect impacts associated with habitat fragmentation (discussed in detail in Section 4.16.1.1.7) and noise disturbances.

Under the No Action Alternative, 66% (135,768 acres) of the total migratory bird habitat in the project area would lose functional value due to fragmentation. This is a 12% increase in unfavorable habitat over current conditions (59% of total migratory bird habitat in the project area unfavorable due to fragmentation). The majority of migratory bird habitat fragmentation under the No Action Alternative would occur in scrub/shrub habitat types (82,954 acres representing 70% of the total scrub/shrub habitat types in the project area), resulting in the greatest impacts to species that use this habitat type (see Table 4-124).

Migratory Birds Determination (No Action)

Implementation of the No Action Alternative may impact individuals, but it **not likely to contribute to the need to become listed**.

Rationale for Migratory Birds Determination (No Action)

None of the migratory birds considered are proposed for listing under the ESA or included on the BLM sensitive species list. Although impacts in the project area could adversely affect local populations or individuals, a relatively small percentage of each species' habitat within their entire range would be impacted by the Proposed Action. In addition, no more than 1.2% of each species' habitat in the project area would be directly impacted (Table 4-123) under the No Action Alternative. Based on this analysis, the BLM has determined that the No Action Alternative would not contribute to the need for federal listing of any of these migratory bird species.

4.12.1.5 ALTERNATIVE E: REDUCED DEVELOPMENT WITH DIRECTIONAL DRILLING

4.12.1.5.1 FEDERALLY LISTED THREATENED, ENDANGERED, AND CANDIDATE SPECIES

4.12.1.5.1.1 Impacts Common to Several Species

These would be of the same nature as described for the Proposed Action (see Section 4.12.1.1.1.1).

4.12.1.5.1.2 Clay Reed-mustard

Impacts to clay reed-mustard under the Alternative E would be the same as under the Proposed Action. No occupied or suitable clay reed-mustard habitat areas would be disturbed (see Map 37).

Clay Reed-mustard Determination (Alternative E)

Implementation of the Alternative E **may affect, but is not likely to adversely affect** the species.

Rationale for Clay Reed-mustard Determination (Alternative E)

The rationale for this determination under Alternative E is the same as described for the Proposed Action.

4.12.1.5.1.3 Shrubby Reed-mustard

Impacts to shrubby reed-mustard under Alternative E would be of the same nature as under the Proposed Action, but would affect 18 (67%) fewer acres of the Badlands Cliff shrubby reed-mustard habitat area (see Map 37). Approximately 9 acres (0.6%) of the Badlands Cliff shrubby reed-mustard habitat area would be disturbed under Alternative E (see Table 4-100). This alternative would have greater impacts than the No Action Alternative due to nearly 9 more acres of disturbance to the Badlands Cliff shrubby reed-mustard habitat area, but would impact 160 fewer acres than the Proposed Action.

As shown above in Table 4-100, 111 acres of the Badlands Cliff shrubby reed-mustard habitat area occur within 300 feet of existing and proposed roads. For the purposes of this analysis, this acreage would be at increased risk for the indirect impacts listed under the Proposed Action. This represents three more acres than the No Action Alternative.

Shrubby Reed-mustard Determination (Alternative E)

Implementation of Alternative E **may affect, and is likely to adversely affect** the species.

Rationale for Shrubby Reed-mustard Determination (Alternative E)

The rationale for this determination is the same as described for the Proposed Action. However, the potential impacts to the species would be somewhat fewer than those under the Proposed Action, as described above.

4.12.1.5.1.4 Pariette Cactus

Impacts to Pariette cactus under Alternative E would be of the same nature as under the Proposed Action, and would not directly impact potential Pariette cactus habitats (see Map 37). Under Alternative E, there would be no direct impacts to the 2009 Pariette cactus core conservation areas, which contain nesting and foraging habitat for the species' insect pollinators. Potential indirect impacts from fugitive dust, invasive weeds, and increased access to potential habitat areas near road development would be considerably reduced compared to the Proposed Action, and slightly less than under the No Action alternative. Under Alternative E, there would be 597 acres of Pariette cactus potential habitat and 24 acres of the 2009 core conservation areas within 300 feet of existing and proposed roads. Applicant-committed measures and conservation measures would minimize the likelihood of direct disturbance of the species if it is encountered outside of its potential habitat areas in project development areas.

Determination for Pariette Cactus (Alternative E)

Implementation of Alternative E **may affect, but is not likely to adversely affect** the species.

Rationale for Pariette Cactus Determination (Alternative E)

The rationale for this determination is the same as that described for the Proposed Action.

4.12.1.5.1.5 Uinta Basin Hookless Cactus

Impacts to Uinta Basin hookless cactus (*Sclerocactus wetlandicus*) under Alternative E would be of the same nature as those under the Proposed Action, but would affect considerably fewer acres in the species' potential habitats (see Map 37). Alternative E would result in the disturbance of 1,097 acres (1.1%) of potential habitats in the project area (see Table 4-102). Applicant-committed measures and conservation measures would minimize the likelihood of direct removal of the species during project construction. Road-associated indirect impacts described under the Proposed Action would occur along approximately 48 miles of new roads in potential habitats under Alternative E. Approximately 18,750 acres of habitat would be within 300 feet of existing and proposed roads, making these habitats more susceptible to the indirect impacts of fugitive dust, sedimentation, and fragmentation and degradation of the cactus' habitat or nesting and foraging habitats for the cactus' insect pollinators Applicant-committed measures would minimize these risks, as described under the Proposed Action. The 1,097 acres of surface disturbance proposed in the cactus's potential habitats under Alternative E has the potential to contain approximately 1,711 plants (see Table 4-103), or up to 2,238 plants, including dessicants. In addition, approximately 976 spine clusters could be located in areas proposed for development under Alternative E.

This alternative would place 1,341 (8%) more acres in proximity to roads than the No Action Alternative. Overall, development under Alternative E would disturb approximately 123 more acres (13%) of the Uinta Basin hookless cactus' potential habitat than would the No Action Alternative. It would also result in 44 miles of road nearly half the miles of road that would occur under the No Action Alternative.

Uinta Basin Hookless Cactus Determination (Alternative E)

Implementation of Alternative E **may affect, and is likely to adversely affect** the species.

Rationale for Uinta Basin Hookless Cactus Determination (Alternative E)

The rationale for this determination under Alternative E is the same as described for the Proposed Action. However, the potential adverse impacts to the species would be considerably fewer than those under the Proposed Action, as described above.

4.12.1.5.1.6 Graham's Beardtongue

Impacts to Graham's Beardtongue occupied habitat (see Map 37) under Alternative E would be the same as under the No Action alternative.

Determination for Graham's Beardtongue (Alternative E)

Implementation of Alternative E **is not likely to jeopardize the continued existence of the species, and is not likely to destroy or adversely modify proposed critical habitat.**

Rationale for Graham's Beardtongue Determination (Alternative E)

The rationale for this determination under Alternative E is the same as described for the Proposed Action. However, the potential impacts to the species would be considerably fewer than those under the Proposed Action, as described above.

4.12.1.5.1.7 Ute Ladies'-tresses

Impacts to the Ute ladies'-tresses under Alternative E would be of the same nature as those under the Proposed Action, but would not impact native riparian habitats where the species potentially occurs. Potential indirect impacts would be considerably reduced due to 219 fewer miles (67%) of road development and associated fugitive dust, weed invasion, sedimentation, and impacts to pollinators due to habitat fragmentation than under the Proposed Action. Like the No Action Alternative, Alternative E would not impact native riparian habitat, but potential for indirect impacts on Ute ladies'-tresses would be greater than the No Action Alternative due to 34 more miles of road.

Ute Ladies'-tresses Determination (Alternative E)

Implementation of Alternative E **may affect, but is not likely to adversely affect** the species.

Rationale for Ute Ladies'-tresses Determination (Alternative E)

The rationale for this determination under Alternative E is the same as described for the Proposed Action. However, the potential impacts to the species would be considerably fewer than those under the Proposed Action, as described above.

4.12.1.5.1.8 Mexican Spotted Owl

Impacts to the MSO under Alternative E would be of the same nature as those under the Proposed Action, but would affect 84 fewer acres of the species' overall potential habitat. No MSO habitat classified as “good” or “fair” in the project area would be disturbed by construction of roads, well pads, and ancillary facilities such as pipelines and evaporative facilities (see Table 4-105). However, approximately 41 acres (0.8%) of the MSO habitat classified as “poor” would be disturbed (see Table 4-105). Alternative E would result in fewer overall impacts to MSO habitat than all of the alternatives, with the exception of the No Action Alternative due to the disturbance of 25 more acres of "poor" habitat. Only 8 acres within a 0.5-mile buffer of MSO habitat would be impacted under this alternative, which is slightly higher than the 5 acres under the No Action Alternative (Table 4-105).

Mexican Spotted Owl Determination (Alternative E)

Implementation of Alternative E **may affect, but is not likely to adversely affect** the species.

Rationale for Mexican Spotted Owl Determination (Alternative E)

Although 41 acres of "poor" MSO habitat would be affected by Alternative E, this constitutes a small percentage of "good" habitat available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat, and eliminate direct impacts to individual birds during the nesting season.

4.12.1.5.1.9 Greater Sage-grouse

Impacts to the greater sage-grouse under Alternative E would be the same as under the Proposed Action, but would affect 600 fewer acres within 2 miles of known leks, 2,237 fewer acres of brooding habitat, and 1,729 fewer acres of wintering habitat. Under Alternative E, approximately 241 acres of surface disturbance by well pads, roads, evaporation facilities, and pipeline corridors would occur within the 2-mile buffer around the known greater sage-grouse lek (see Table 4-106). This would comprise 3.0% of the 8,032 acres within the buffer zone. Approximately 811 acres of surface disturbance would occur within the 84,647 acres of UDWR-designated brooding habitat, constituting a conversion of 1.0% of total available acres in the project area. Roads proposed under Alternative E (along with existing roads) would contribute to the devaluation or degradation of 59,441 acres (or 70.2%) of the 84,647 acres of potential sage-grouse habitat in the project area. Approximately 538 acres of surface disturbance would occur within the 38,747 acres of UDWR-designated wintering habitat, constituting a conversion of 1.4% of total available acres in the project area.

Greater Sage-grouse Determination (Alternative E)

Implementation of Alternative E may impact and could lead to a downward population trend, but **would not likely contribute to the listing of the species.**

Rationale for Greater Sage-grouse Determination (Alternative E)

Although 241 acres within 2 miles of a known (inactive) lek, 811 acres of potential brooding habitat, and 538 acres of potential wintering habitat would be directly impacted by Alternative E, this constitutes a small percentage of such habitats available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat and eliminate direct impacts to individual birds during the nesting season. Although Alternative E may result in direct and indirect adverse impacts to greater sage-grouse in the project area, the probability is relatively low based on the percentage of habitat that could be disturbed during the life of the project.

4.12.1.5.1.10 Western Yellow-billed Cuckoo

Impacts to the WYBC under Alternative E would be of the same nature as under the Proposed Action, but would affect far fewer acres of the species' habitat. Under Alternative E, 23 fewer acres of potential habitat (riparian vegetation) are anticipated to be impacted than under the Proposed Action, with a total of 0.5% of the total suitable riparian habitat in the project area impacted (Table 4-107). Out of the alternatives, Alternative E would result in the least impacts to this species, but would be only slightly less than the impacts under Alternative C and the No Action Alternative. Depending on the specific importance of the impacted riparian area in the project area, the impacts could be more or less severe.

Adverse impacts to the species would be mitigated by restricting new surface-disturbing activities within 330 feet of riparian areas. In wet meadows, springs, and seeps, surveys to assess riparian habitat on a case-by-case basis would take place prior to the initiation of any construction activities. If the species or habitat for the WYBC is found, then the area would be avoided if possible.

Western Yellow-billed Cuckoo Determination (Alternative E)

Implementation of Alternative E may impact and could lead to a downward population trend, but **would not likely contribute to the listing of the species.**

Rationale for Western Yellow-billed Cuckoo Determination (Alternative E)

Based on this analysis and conservation and applicant-committed measures, the BLM has determined that Alternative E may affect, but would not be likely to adversely affect WYBC habitat. This would be due to the avoidance of important riparian areas, the small percentage of overall impacted riparian habitat in the project area, and site-specific surveys prior to any construction activities being initiated.

4.12.1.5.1.11 Threatened, Endangered, and Candidate Fish Species

Impacts to Colorado River fish under Alternative E would be of the same nature as under the Proposed Action, but would result in impacts of lesser magnitude, including less depletion of the Green River, less disturbance of erosive soils, and a slightly lower risk of a pipeline spill. Under Alternative E, approximately 347 pipeline crossings of intermittent/ephemeral drainages that are tributary to the Green River would be required. A total of seven wells (from 2 pads) are proposed within the 100-year floodplain for the Green River, as well as 0.6 mile of roads and pipelines. An additional 31 wells (from 8 pads) are proposed within 100-year floodplains of Green River tributaries within 5 miles of the river, along with 11 miles of pipeline (see Table 4-108).

The risk of acute or chronic toxicity to endangered fish in the Green River in the event of a natural-gas condensate spill would be the same as under the Proposed Action, although the likelihood of a spill would be reduced. The 0.6 mile of pipeline in the Green River floodplain under Alternative E would carry a risk of 0.018 incident over their 30-year production phase, or one incident every 1,742 years. The 10.9 miles of pipeline crossing floodplains within 5 miles of the Green River would carry a risk of 0.33 incident over the 30-year production phase over which each pipeline would be used, or one incident every 92 years. However, spill attenuation would greatly reduce the risk of a spill reaching the Green River before it evaporated.

Under Alternative E, approximately 215 acre-feet of water from the Green River Basin would be consumed over the lifetime of the project (see Table 4-129). Peak annual withdrawals from sources that feed the Green River would be the same as under the Proposed Action (approximately 23 acre-feet per year; see Table 4-129). This equates to approximately 0.04 cfs of withdrawal and would represent a loss of approximately 0.005% of the approximately 1,000 cfs recorded minimum stream flow of the Green River adjacent to the project area. This flow reduction would be considered a long-term (life of the project) impact in terms of reductions in habitat for listed fish species in the Green River. Approximately 1.4 acres of water-erosive soils would be disturbed (see Table 4-108). Project-related disturbance would increase the Green River's sediment load by approximately 27,276 tons/year, or 0.01% (see Table 4-131 in Section 4.15.1.1.2.2).

Alternative E would result in slightly greater adverse impacts to Colorado River fish than would occur under the No Action Alternative. Compared to the No Action Alternative, development under Alternative E would consume 144 more acre-feet of water from the Green River Basin, result in the disturbance of 8.6 fewer acres of highly erosive soils, and require 126 fewer intermittent/ephemeral stream crossings by pipelines. Alternative E would also result in 3 more wells in the Green River floodplain, and 25 more wells (with 3.4 more miles of pipeline) crossing floodplains within 5 miles of the Green River.

Colorado River Endangered Fish Determinations (Alternative E)

Implementation of Alternative E **may affect, and is likely to adversely affect**, all Colorado River endangered fish.

Colorado River Endangered Fish Determination Rational (Alternative E)

The rationale for the determination above is the same as described for the Proposed Action.

4.12.1.5.2 State of Utah and BLM Sensitive Species

4.12.1.5.2.1 Untermann Daisy

Impacts to the Untermann daisy under Alternative E would be of the same nature as those under the Proposed Action, but would affect 597 acres (1.3%) of potential Untermann daisy habitat in the project area (see Table 4-109; Map 37). Approximately 9,028.7 acres of Untermann daisy habitat would be effectively placed within 300 feet of existing and proposed roads under this alternative, which is 1,477 more acres than the No Action Alternative. Overall, Alternative E would result in greater adverse impacts to the Untermann daisy than would occur under the No Action Alternative due to 316 more acres of disturbance, 34 (47%) more miles of new roads, and associated indirect impacts from fugitive dust, weed invasion, herbicides, and habitat fragmentation.

Determination for Untermann Daisy (Alternative E)

Implementation of Alternative E may affect individuals, but is **not likely to contribute to the need to become listed.**

Rationale for Untermann Daisy Determination (Alternative E)

The rationale for this determination under Alternative E is the same as described for the Proposed Action. However, the potential impacts to the species would be considerably fewer than those under the Proposed Action, as described above.

4.12.1.5.2.2 Sterile Yucca

Impacts to sterile yucca under Alternative E would be of the same nature as those under the Proposed Action, but would directly affect 0.06 fewer acres (7.1%) and indirectly affect 1.1 fewer acres of known sterile yucca habitat than under the Proposed Action (see Table 4-110; Map 37).

Sterile Yucca Determination (Alternative E)

Implementation of Alternative E may affect individuals, but is **not likely to contribute to the need to become listed**.

Rationale for Sterile Yucca Determination (Alternative E)

Because direct impacts to the sterile yucca's habitat would total less than than 2% of the known habitat available in the project area, and because considerable additional habitat exists beyond the project area, project-related activities are not likely to contribute to the need for federal listing of the species. In addition, site-specific avoidance and minimization measures, where required by the AO, would further reduce direct or indirect impacts to sterile yucca individuals and habitats.

4.12.1.5.2.3 Graham's Catseye, Barneby's Catseye, Goodrich's Blazingstar, Goodrich's Columbine, and Uinta Greenthread

Because the acreages of the potential habitats for these five species have not been mapped or determined for the project area, impacts are broadly described and compared between the action alternatives. In general, direct and indirect impacts to these five plant species under Alternative E would be comparable to the nature and degree of impacts described for other State of Utah and BLM sensitive plant species associated with similar Green River shale habitats, which are the similar as would occur under the Proposed Action. However, there would be 219 (33%) fewer miles of new roads than under the Proposed Action, and 34 miles (53%) less than under the No Action alternative.

Graham's catseye, Barneby's catseye, Goodrich's blazingstar, Goodrich's columbine, and Uinta greenthread Determination (Alternative E)

Implementation of Alternative E may affect individuals, but is **not likely to contribute to the need for listing for any of the five species**.

Rationale for Graham's catseye, Barneby's catseye, Goodrich's blazingstar, Goodrich's columbine, and Uinta greenthread Determination (Alternative E)

Because additional habitats for Graham's catseye, Barneby's catseye, Goodrich's blazingstar, Goodrich's columbine, and Uinta greenthread exist beyond the project area, and because site-specific avoidance and minimization measures, where required by the AO, would further reduce direct or indirect impacts to individuals and habitats, project-related activities are not likely to contribute to the need for federal listing of these species.

4.12.1.5.2.4 White-tailed Prairie Dog

Impacts to the white-tailed prairie dog under Alternative E would be of the same nature as under the Proposed Action, but would affect fewer acres of occupied habitat than all of the other alternatives analyzed. Surface disturbing activities associated with the Proposed Action (e.g., the construction of well pads, pipelines, and access roads) would result in the loss of approximately 176 discontinuous acres of prairie dog habitat in the project area, or 1.1% of the habitat present (see Table 4-111).

White-tailed Prairie Dog Determination (Alternative E)

Implementation of Alternative E may affect individuals, but is **not likely to contribute to the need to become listed.**

Rationale for White-tailed Prairie Dog Determination (Alternative E)

The rationale for this determination under Alternative E is the same as described for the Proposed Action. In addition, the amount of habitat impacted by this alternative is considerably lower than that under the Proposed Action.

4.12.1.5.2.5 Big Free-tailed Bat

Impacts to the big free-tailed bat would be of the same nature as those described under the Proposed Action. Surface-disturbing activities under Alternative E would impact 46 acres (1.2%) of potential roosting habitat, and 1,535 acres (1.2%) of potential foraging habitat (see Table 4-112). Alternative E would result in approximately the same amount of impacts to the big free-tailed bat than would occur under the No Action Alternative. Compared to the No Action Alternative, development under Alternative E would result in the disturbance of 15 more roosting acres and six fewer foraging acres of big free-tailed bat potential habitat.

Big Free-tailed Bat Determination (Alternative E)

Implementation of Alternative E may affect individuals, but is **not likely to contribute to the need to become listed.**

Rationale for Big Free-tailed Bat Determination (Alternative E)

The rationale for this determination under Alternative E is the same as that described for the Proposed Action. In addition, the amount of big free-tailed bat potential habitat impacted by this alternative would be considerably lower than under the Proposed Action.

4.12.1.5.2.6 Spotted Bat

Impacts to the spotted bat would be of the same nature as those described under the Proposed Action. Surface-disturbing activities under Alternative E would impact 46 acres (1.2%) of roosting habitat, and 1,792 acres (0.9%) of foraging habitat (see Table 4-113). Alternative E would result in slightly more impacts to roosting habitat, and slightly fewer impacts to foraging habitat than would occur under the No Action Alternative. Compared to the No Action Alternative, development under Alternative E would result in the disturbance of 15 more roosting acres and 141 fewer foraging acres of spotted bat habitat.

Spotted Bat Determination (Alternative E)

Implementation of Alternative E may affect individuals, but is **not likely to contribute to the need to become listed.**

Rationale for Spotted Bat Determination (Alternative E)

The rationale for this determination under Alternative E is the same as that described for the Proposed Action. In addition, the amount of big free-tailed bat habitat impacted by this alternative would be considerably lower than under the Proposed Action.

4.12.1.5.2.7 Burrowing Owl

Impacts to the burrowing owl under Alternative E would be of the same nature as those under the Proposed Action, but would affect fewer acres within 0.5 mile of known owl nests. Under Alternative E, 2 acres within 0.5-mile nest buffer areas would be directly converted to well pads, roads, and other facilities (see Table 4-114). In addition, surface-disturbing activities under Alternative E (e.g., the construction of well pads, pipelines, and access roads) would result in the loss of approximately 176 acres of prairie dog/burrowing owl habitat in the project area (see Table 4-111). Alternative E would result in lesser adverse impacts to the burrowing owl than would occur under the No Action Alternative. Compared to the No Action Alternative, development under Alternative E would result in the disturbance of 12 fewer acres of the owl's habitat.

Burrowing Owl Determination (Alternative E)

Implementation of Alternative E may affect individuals, but is **not likely to contribute to the need to become listed.**

Rationale for Burrowing Owl Determination (Alternative E)

Although 2 acres of burrowing owl nesting and 176 acres of prairie dog/burrowing owl habitat would be directly impacted by Alternative E, this constitutes a small percentage of suitable habitat available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat and eliminate direct impacts to individual birds during the nesting season. While Alternative E would result in direct and indirect adverse impacts to burrowing owls, the probability is relatively low based on the percentage of habitat that could be disturbed during the life of the project.

4.12.1.5.2.8 Ferruginous Hawk

Impacts to the ferruginous hawk under Alternative E would be of the same nature as those under the Proposed Action, but would affect fewer acres within 0.5 mile of known hawk nests. Under the No Action Alternative, 184 acres (1.3%) within the 0.5-mile buffer around ferruginous hawk nesting areas would be directly converted to well pads, roads, or other facilities. In addition, the construction of well pads and roads would effectively remove 1,679 acres (or 1.1%) of potential foraging habitat from use by foraging ferruginous hawks.

Determination for Ferruginous Hawk (Alternative E)

Implementation of Alternative E **may affect individuals, but is not likely to contribute to the need to become listed.**

Rationale for Ferruginous Hawk Determination (Alternative E)

Although 1,679 acres of foraging habitat and 184 acres of nesting habitat would be directly impacted by Alternative E, this constitutes a small percentage of suitable habitat available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat, and eliminate direct impacts to individual birds during the nesting season. While Alternative E could potentially result in direct and indirect adverse impacts to ferruginous hawks, the probability is relatively low based on the percentage of habitat that could be disturbed during the life of the project.

4.12.1.5.2.9 Bald Eagle

Impacts to bald eagles under the Alternative E would be of the same nature as those under the Proposed Action, but would affect fewer acres of the species' roosting habitat. Impacts to wintering bald eagles would include the long-term surface disturbance, fragmentation, and human-disturbance of approximately 24 acres of winter roosting habitat within 0.5 mile of known winter roosting areas. This is approximately 0.6% of the bald eagle winter roosting habitat in the project area that would be disturbed by construction of roads, well pads, and ancillary facilities such as pipelines (see Table 4-116). In addition, no acres of all potential roosting habitat (riparian) in the project area would be disturbed. Road-associated impacts described under the Proposed Action would occur along approximately 106 miles of new roads in the project area under Alternative E.

Bald Eagle Determination (Alternative E)

Implementation of Alternative E may affect individuals, but is **not likely to contribute to the need to become listed.**

Rationale for Bald Eagle Determination (Alternative E)

Although 24 acres of bald eagle winter roosting habitat within 0.5 mile of known winter roosting areas would be directly impacted by Alternative E, this constitutes a small percentage of suitable habitat available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat, and eliminate direct impacts to individual birds during the nesting season. While Alternative E could potentially result in direct and indirect adverse impacts to bald eagles, the probability is relatively low based on the percentage of habitat that could be disturbed during the life of the project.

4.12.1.5.2.10 Golden Eagle

Short- and long-term direct and indirect impacts of well development on golden eagles are identical to those described in Section 4.12.1.1.3.1, Raptors. All applicant-committed measures will be followed as stated in Section 2.2.9.6.

Surface-disturbing activities under Alternative E would impact 204 acres of nest buffer area. Temporal and spatial buffers apply to this nest buffer area, and would be prescribed during site-specific surveys. The activity of the affected nests would also be determined during site-specific surveys. Alternative E would result in slightly more impacts to the golden eagle than would occur under the No Action Alternative. Compared to the No Action Alternative, development under Alternative E would result in the disturbance of 63 more acres of nest buffer area. However, the disturbance of this nest buffer area is negligible due to applicant-committed measures and BMPs.

Golden Eagle Determination (Alternative E)

Implementation of Alternative E may affect individuals, but is **not likely to contribute to the need to become listed.**

Rationale for Golden Eagle Determination (Alternative E)

Although 204 acres within 0.5 mile of a known golden eagle nest would be directly impacted by Alternative E surface disturbance; this constitutes a small percentage of suitable habitat available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat and eliminate direct impacts to individual birds during the nesting season. While Alternative E could potentially result in direct and indirect adverse impacts to golden eagles, the probability is relatively low based on number of nests that could be disturbed during the life of the project.

4.12.1.5.2.11 Short-eared Owl

Impacts to the short-eared owl under the Alternative E would be of the same nature as those under the Proposed Action, but would affect fewer acres within the owl's potential habitat. Under the Proposed Action, approximately 1,679 acres of well pads and roads would be constructed in short-eared owl habitat, rendering 1.1% of this area unusable to owls for the life of the project (see Table 4-118).

Short-eared Owl Determination (Alternative E)

Implementation of Alternative E may affect individuals, but is **not likely to contribute to the need to become listed.**

Rationale for Short-eared Owl Determination (Alternative E)

Although 1,679 acres surface disturbance of potential short-eared owl habitat would be directly impacted by Alternative E, this constitutes a small percentage of such habitats available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat and eliminate direct impacts to individual birds during the nesting season. While Alternative E could potentially result in direct and indirect adverse impacts to short-eared owls, the probability is relatively low based on the percentage of habitat that could be disturbed during the life of the project. Based on this analysis, conservation measures, and applicant-committed measures, the BLM has determined that Alternative E would not likely contribute to the need for federal listing.

4.12.1.5.2.12 Lewis' Woodpecker

Impacts to the Lewis' woodpecker would be of the same nature as those described under the Proposed Action. Surface-disturbing activities under Alternative E would impact 134 acres (0.3%) of Lewis' woodpecker habitat. Alternative E would result in fewer impacts to Lewis' woodpecker habitat than would occur under the No Action Alternative. Compared to the No Action Alternative, development under Alternative E would result in the disturbance of 153 fewer acres of habitat.

Lewis' Woodpecker Determination (Alternative E)

Implementation of Alternative E may affect individuals, but is **not likely to contribute to the need to become listed.**

Rationale for Lewis' Woodpecker Determination (Alternative E)

Although 134 acres surface disturbance of potential Lewis' woodpecker habitat would be directly impacted by Alternative E, this constitutes a small percentage of such habitats available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat and eliminate direct impacts to individual birds during the nesting season. While the Alternative E could potentially result in direct and indirect adverse impacts to Lewis' woodpecker, the probability is relatively low based on the percentage of habitat that could be disturbed during the life of the project.

4.12.1.5.2.13 Mountain Plover

Impacts to the mountain plover would be similar to those described under the Proposed Action. Surface-disturbing activities under Alternative E would impact 284 acres of mountain plover known breeding habitat (1.2%). Alternative E would result in a lesser impact to mountain plover known breeding habitat than would occur under the No Action Alternative. Compared to the No Action Alternative, development under Alternative E would result in the disturbance of 215 fewer acres of known breeding habitat (see Table 4-120).

Mountain Plover Determination (Alternative E)

Implementation of Alternative E may impact individuals, but is **not likely to contribute to the need to become listed**.

Rationale for Mountain Plover (Alternative E)

Although 284 acres of surface disturbance of potential mountain plover habitat would be directly impacted by Alternative E, this constitutes a small percentage of such habitats available both within the project area and throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat, and eliminate direct impacts to individual birds during the nesting season.

4.12.1.5.2.14 Sensitive Fish Species

Impacts to roundtail chub, bluehead sucker, and flannelmouth sucker would be the same as the impacts to federally listed Colorado River fish, as described in Section 4.12.1.2.1.11.

Colorado River Sensitive Fish Determinations (Alternative E)

Implementation of Alternative E may affect individuals, but is **not likely to contribute to the need to become listed**.

Colorado River Sensitive Fish Determination Rational (Alternative E)

The rationale for the determination above is the same as described for the Proposed Action.

4.12.1.5.3 Other Special Status Species Retained for Analysis

4.12.1.5.3.1 Raptors

Under Alternative E, 489 acres of surface disturbance would occur within 0.5-mile of raptor nests. This represents 1.3% of the total raptor nesting buffer in the project area (see Table 4-122).

Road-related disturbance to raptors would result from the construction of 27 miles of new roads within 0.5-mile of raptor nests under Alternative E (see Table 4-122). This represents approximately twice the roads in buffered raptor nesting areas that would occur under the No Action alternative and would be a 20% increase over current conditions.

Raptor Determination (Alternative E)

The implementation of Alternative E may affect individuals, but is **not likely to contribute to the need to become listed.**

Rationale for Raptor Determination (Alternative E)

Although 489 acres of raptor nesting habitat would be directly impacted by Alternative E surface disturbance; this constitutes a small percentage of such habitats available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat and eliminate direct impacts to individual birds during the nesting season. While Alternative E could potentially result in direct and indirect adverse impacts to raptor nesting habitat, the probability is relatively low based on the percentage of habitat that could be disturbed during the life of the project.

4.12.1.5.3.2 Migratory Birds

A total of approximately 2,174 acres of surface disturbance would occur on land within migratory bird habitat under Alternative E. This represents approximately 1.05% of total migratory bird habitat in the project area (see Table 4-124).

Road-related disturbance to migratory birds would result from the construction of 106 miles of new roads under Alternative E. This represents a 19% increase over current conditions, and 47% greater road-related disturbance than the No Action Alternative. Under the Proposed Action, there would be an estimated 6.5% maximum increase in traffic volume over current conditions (see Section 4.5, Table 4-75). The construction of new roads would also have indirect impacts associated with habitat fragmentation (discussed in detail in Section 4.16.1.1.7) and noise disturbances.

Under Alternative E, 68% (140,286 acres) of the total migratory bird habitat in the project area would lose functional value due to fragmentation. This is a 16% increase in unfavorable habitat over current conditions (59% of total migratory bird habitat in the project area is currently unfavorable due to fragmentation), and a 3% increase over the No Action Alternative (see Table 4-124).

Migratory Birds Determination (Alternative E)

The implementation of Alternative E may affect individuals, but is **not likely to contribute to the need to become listed**.

Rationale for Migratory Birds Determination (Alternative E)

None of the migratory birds considered are proposed for listing under the ESA or included on the BLM sensitive species list. Although impacts in the project area could adversely affect local populations or individuals, a relatively small percentage of each species' habitat within their entire range would be impacted by the Proposed Action. In addition, no more than 1.4% of each species' habitat in the project area would be directly impacted (Table 4-123) under Alternative E. Based on this analysis, the BLM has determined that Alternative E would not contribute to the need for federal listing of any of these migratory bird species.

4.12.1.6 Alternative F: Agency Preferred Alternative

4.12.1.6.1 Federally Listed Threatened, Endangered, and Candidate Species

4.12.1.6.1.1 Impacts Common to Several Species

These would be of the same nature as described for the Proposed Action (see Section 4.12.1.1.1.1).

4.12.1.6.1.2 Clay Reed-mustard

Impacts to clay reed-mustard under the Alternative F would be the same as under the Proposed Action. No occupied or suitable clay reed-mustard habitat areas would be disturbed.

Clay Reed-mustard Determination (Alternative F)

Implementation of the Alternative F **may affect, but is not likely to adversely affect** the species.

Rationale for Clay Reed-mustard Determination (Alternative F)

The rationale for this determination under Alternative F is the same as described for the Proposed Action.

4.12.1.6.1.3 Shrubby Reed-mustard

Impacts to shrubby reed-mustard under Alternative F would be of the same nature as under the Proposed Action, but would affect 5 more acres of the Badlands Cliff shrubby reed-mustard habitat area (see Map 37). Approximately 32 acres (2.5%) of the Badlands Cliff shrubby reed-mustard habitat area would be disturbed under Alternative F (see Table 4-100). This alternative would also have greater impacts than the No Action Alternative due to 32 more acres of disturbance to the Badlands Cliff shrubby reed-mustard habitat area.

As shown above in Table 4-100, 296 acres of the Badlands Cliff shrubby reed-mustard habitat area occur within 300 feet of existing and proposed roads. For the purposes of this analysis, this acreage would be at increased risk for the indirect impacts listed under the Proposed Action. This represents 188 more acres than the No Action Alternative.

Shrubby Reed-mustard Determination (Alternative F)

Implementation of Alternative F **may affect, and is likely to adversely affect** the species.

Rationale for Shrubby Reed-mustard Determination (Alternative F)

The rationale for this determination is the same as described for the Proposed Action. However, the potential impacts to the species would be somewhat fewer than those under the Proposed Action, as described above.

4.12.1.6.1.4 Pariette Cactus

Impacts to Pariette cactus under Alternative F would be of the same nature as under the Proposed Action. There would be no direct impacts to previously known Pariette cactus habitats or any of the 2009 Pariette cactus core conservation areas, which contain nesting and foraging habitat for the species' insect pollinators. Potential indirect impacts from fugitive dust, invasive weeds, and increased access to potential habitat areas near road development would be considerably reduced compared to the Proposed Action, and less than the No Action alternative.

Under Alternative F, there would be 579 acres of Pariette cactus potential habitat and 24 acres of the 2009 core conservation areas within 300 feet of existing and proposed roads. Applicant-committed conservation measures would minimize the likelihood of direct disturbance of the species if it is encountered outside of its currently known potential habitat areas in project development areas. Under this alternative, occupied habitat for any newly found Pariette cacti would be avoided.

Determination for Pariette Cactus (Alternative F)

Implementation of Alternative F **may affect, but is not likely to adversely affect** the species.

Rationale for Pariette Cactus Determination (Alternative F)

The rationale for this determination is the same as that described for the Proposed Action.

4.12.1.6.1.5 Uinta Basin Hookless Cactus

Impacts to Uinta Basin hookless cactus (*Sclerocactus wetlandicus*) under Alternative F would be of the same nature as those under the Proposed Action, but would affect considerably fewer acres in the species' potential habitats (see Map 37). Alternative F would result in the disturbance of 499 acres (0.9%) of potential habitats in the project area (see Table 4-102). Applicant-committed measures and conservation measures would minimize the likelihood of direct removal of the species in currently known potential habitat during project construction. Road-associated indirect impacts described under the Proposed Action would occur along approximately 92 miles of new roads in potential habitats under Alternative F. Approximately 21,581 acres of habitat would be within 300 feet of existing and proposed roads, making these habitats more susceptible to the indirect impacts of fugitive dust, sedimentation, and fragmentation and degradation of the cactus' habitat or nesting and foraging habitats for the cactus' insect pollinators. Applicant-committed measures would minimize these risks, as described under the Proposed Action. The 499 acres of surface disturbance proposed in the cactus's potential habitats under Alternative F has the potential to contain approximately 778 plants (seeTable 4-103). Including desiccants, up to 1,018 plants may be located in areas proposed for development under Alternative F, in addition to approximately 444 spine clusters.

This alternative would place 14,485 more acres in proximity to roads than the No Action Alternative. Overall, development under Alternative F would disturb approximately 41 fewer acres (8%) of the Uinta Basin hookless cactus' potential habitat than would the No Action Alternative. It would also result in 79 more miles of road; 7 times more road than under the No Action Alternative.

Determination for Uinta Basin Hookless Cactus (Alternative F)

Implementation of Alternative F **may affect, and is likely to adversely affect** the species.

Rationale for Uinta Basin Hookless Cactus Determination (Alternative F)

The rationale for this determination under Alternative F is the same as described for the Proposed Action. However, the potential adverse impacts to the species would be considerably fewer than those under the Proposed Action, as described above.

4.12.1.6.1.6 Graham's Beardtongue

Impacts to Graham's Beardtongue under Alternative F would be the same as under the No Action Alternative.

Determination for Graham's Beardtongue (Alternative F)

Implementation of Alternative F **is not likely to jeopardize the continued existence of the species, and is not likely to destroy or adversely modify proposed critical habitat.**

Rationale for Graham's Beardtongue Determination (Alternative F)

The rationale for this determination under Alternative F is the same as described for the No Action Alternative and the Proposed Action. However, the potential impacts to the species would be considerably fewer than those under the Proposed Action, as described under the No Action Alternative.

4.12.1.6.1.7 Ute Ladies'-tresses

Impacts to the Ute ladies'-tresses under Alternative F would be of the same nature as those under the Proposed Action, but would not impact native riparian habitats where the species potentially occurs. Potential indirect impacts would be considerably reduced due to 127 fewer miles (39%) of road development and associated fugitive dust, weed invasion, sedimentation, and impacts to pollinators due to habitat fragmentation than under the Proposed Action. Like the No Action Alternative, Alternative F would impact no riparian habitat, but potential for indirect impacts would be greater than the No Action Alternative due to 126 additional miles of road.

Determination for Ute Ladies'-tresses (Alternative F)

Implementation of Alternative F **may affect, but is not likely to adversely affect** the species.

Rationale for Ute Ladies'-tresses Determination (Alternative F)

The rationale for this determination under Alternative F is the same as described for the Proposed Action. However, the potential impacts to the species would be considerably fewer than those under the Proposed Action, as described above.

4.12.1.6.1.8 Mexican Spotted Owl

Impacts to the MSO under Alternative F would be of the same nature as those under the Proposed Action, but would affect 45 fewer acres of the species' overall potential habitat. No MSO habitat classified as "good" or "fair" in the project area would be disturbed by construction of roads, well pads, and ancillary facilities such as pipelines and evaporative facilities (see Table 4-105). However, approximately 80 acres (0.8%) of the MSO habitat classified as "poor" would be disturbed (see Table 4-105). Approximately 42 acres within the 0.5-mile buffer of MSO habitat is expected to be impacted under this alternative. Alternative F would result in fewer overall impacts to MSO habitat than all of the alternatives, with the exception of the No Action Alternative and Alternative E, due to the disturbance of 64 and 39 more acres of "poor" habitat, respectively.

Mexican Spotted Owl Determination (Alternative F)

Implementation of Alternative F **may affect, but is not likely to adversely affect** the species.

Rationale for Mexican Spotted Owl Determination (Alternative F)

Although 80 acres of "poor" MSO habitat would be affected by Alternative F, this constitutes a small percentage of "good" habitat available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat, and eliminate direct impacts to individual birds during the nesting season.

4.12.1.6.1.9 Greater Sage-grouse

Impacts to the greater sage-grouse under Alternative F would be the same as under the Proposed Action, but would affect 546 fewer acres within 2 miles of known leks and 981 fewer acres of brooding habitat. Under Alternative F, approximately 295 acres of surface disturbance by well pads, roads, evaporation facilities, and pipeline corridors would occur within the 2-mile buffer around known greater sage-grouse leks (see Table 4-106). This would comprise 3.7% of the 8,032 acres within the buffer zone. Approximately 1,899 acres of surface disturbance would occur within the 84,647 acres of UDWR-designated brooding habitat, constituting a conversion of 2.2% of total available acres in the project area. Roads proposed under Alternative F (along with existing roads) would contribute to the devaluation or degradation of 65,686 acres (or 96.3%) of the 84,647 acres of potential sage-grouse habitat in the project area. Approximately 1,035 acres of surface disturbance would occur within the 38,747 acres of UDWR-designated wintering habitat, constituting a conversion of 2.7% of total available acres in the project area.

Greater Sage-grouse Determination (Alternative F)

Implementation of Alternative F may impact and could lead to a downward population trend, but **would not likely contribute to the listing of the species.**

Rationale for Greater Sage-grouse Determination (Alternative F)

Although 295 acres within 2 miles of a known (inactive) lek and 1,899 acres of potential brooding habitat would be directly impacted by Alternative F; this constitutes a small percentage of such habitats available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat and eliminate direct impacts to individual birds during the nesting season. Although Alternative F may result in direct and indirect adverse impacts to greater sage-grouse in the project area, the probability is relatively low based on the percentage of habitat that could be disturbed during the life of the project.

4.12.1.6.1.10 Western Yellow-billed Cuckoo

There would be no impacts to the WYBC under Alternative F. Under Alternative F, no acres of suitable riparian habitat are anticipated to be impacted (Table 4-107). Out of the alternatives, Alternative F would result in the least impacts to this species, which would be 8 acres less than the No Action Alternative. Alternative F is not expected to impact any riparian areas.

Western Yellow-billed Cuckoo Determination (Alternative F)

Implementation of Alternative F **may affect, but is not likely to adversely affect the species.**

Rationale for WesternYellow-billed Cuckoo Determination (Alternative F)

Based on this analysis and conservation and applicant-committed measures, the BLM has determined that Alternative F will not likely adversely affect WYBC habitat. This would be due to the avoidance of all riparian areas.

4.12.1.6.1.11 Threatened, Endangered, and Candidate Fish Species

Impacts to Colorado River fish under Alternative F would be much less than under the Proposed Action, resulting in impacts of lesser magnitude, including less depletion of the Green River, less disturbance of erosive soils, and a slightly lower risk of a pipeline spill. Under Alternative F, approximately 744 pipeline crossings of intermittent/ephemeral drainages that are tributary to the Green River would be required. No wells, roads, or pipelines are proposed within the 100-year floodplain for the Green River. In addition, no wells or pipelines are proposed within 100-year floodplains of Green River tributaries within 5 miles of the river (see Table 4-108).

The risk of acute or chronic toxicity to endangered fish in the Green River in the event of a natural-gas condensate spill would be the same as under the Proposed Action, although the likelihood of a spill would be reduced. Due to no pipelines in the Green River floodplain under Alternative F, it would carry little to no risk of incidents over their 30-year production phase. The 61.9 miles of pipeline crossing floodplains within 5 miles of the Green River would carry a risk of 1.86 incidents over the 30-year production phase over which each pipeline would be used, or one incident every 16.2 years. However, spill attenuation would greatly reduce the risk of a spill reaching the Green River before it evaporated.

Under Alternative F, approximately 251 acre-feet of water from the Green River Basin would be consumed over the lifetime of the project (see Table 4-129). Peak annual withdrawals from sources that feed the Green River would be the same as under the Proposed Action (approximately 23 acre-feet per year; seeTable 4-129). This equates to approximately 0.04 cfs of withdrawal and would represent a loss of approximately 0.005% of the approximately 1,000 cfs recorded minimum stream flow of the Green River adjacent to the project area. This flow reduction would be considered a long-term (life of the project) impact in terms of reductions in habitat for listed fish species in the Green River. Approximately 21 acres of water-erosive soils would be disturbed (see Table 4-108). Project-related disturbance would increase the Green River's sediment load by approximately 47,817 tons/year, or 0.01% (see Table 4-131).

Alternative F would result in more adverse impacts to Colorado River fish than would occur under the No Action Alternative, but less adverse impacts than under the other action alternatives. Compared to the No Action Alternative, development under Alternative F would consume 170 less acre-feet of water from the Green River Basin, result in the disturbance of 12 more acres of highly/moderately water erosive soils, and require 271 more intermittent/ephemeral stream crossings by pipelines. Alternative F would also result in four less wells in the Green River floodplain, and six less wells within 5 miles of the Green River.

Colorado River Endangered Fish Determinations (Alternative F)

Implementation of Alternative F **may affect, and is likely to adversely affect**, all Colorado River endangered fish.

Colorado River Endangered Fish Determination Rationale (Alternative F)

The rationale for the determination above is the same as described for the Proposed Action.

4.12.1.6.2 State of Utah and BLM Sensitive Species

4.12.1.6.2.1 Untermann Daisy

Impacts to the Untermann daisy under Alternative F would be of the same nature as those under the Proposed Action, but would affect 1,152 acres (2.5%) of potential Untermann daisy habitat in the project area (see Table 4-109; Map 37). Approximately 11,436 acres of Untermann daisy habitat would be effectively placed within 300 feet of existing and proposed roads under this alternative, which is 10,693 more acres than the No Action Alternative. Overall, Alternative F would result in greater adverse impacts to the Untermann daisy than would occur under the No Action Alternative due to 817 more acres of disturbance, 126 (57%) more miles of new roads, and associated indirect impacts from fugitive dust, weed invasion, herbicides, and habitat fragmentation.

Determination for Untermann Daisy (Alternative F)

Implementation of Alternative F may affect individuals, but is **not likely to contribute to the need to become listed.**

Rationale for Untermann Daisy Determination (Alternative F)

The rationale for this determination under Alternative F is the same as described for the Proposed Action. However, the potential impacts to the species would be slightly fewer than those under the Proposed Action, as described above.

4.12.1.6.2.2 Sterile Yucca

Impacts to sterile yucca under Alternative F would be of the same nature as those under the Proposed Action, but would directly affect 0.08 more acres (3.5%) than under the Proposed Action (see Table 4-110; Map 37). Indirect effects to known sterile yucca habitats would the same as under the Proposed Action.

Sterile Yucca Determination (Alternative F)

Implementation of Alternative F may affect individuals, but is **not likely to contribute to the need to become listed**.

Rationale for Sterile Yucca Determination (Alternative F)

Because direct impacts to the sterile yucca's habitat would total less than than 4% of the known habitat available in the project area, and because considerable additional habitat exists beyond the project area, project-related activities are not likely to contribute to the need for federal listing of the species. In addition, site-specific avoidance and minimization measures, where required by the AO, would further reduce direct or indirect impacts to sterile yucca individuals and habitats.

4.12.1.6.2.3 Graham's Catseye, Barneby's Catseye, Goodrich's Blazingstar, Goodrich's Columbine, and Uinta Greenthread

Because the acreages of the potential habitats for these five species have not been mapped or determined for the project area, impacts are broadly described and compared between the action alternatives. In general, direct impacts to these five plant species under Alternative F would be comparable to the nature and degree of impacts described for other State of Utah and BLM sensitive plant species associated with similar Green River shale habitats, which are slightly reduced compared to the Proposed Action. However, indirect impacts would be increased due to 198 miles of new road, which is 127 (39%) more miles than would occur under the Proposed Action, and 92 (128%) more miles than under the No Action alternative.

Graham's catseye, Barneby's catseye, Goodrich's blazingstar, Goodrich's columbine, and Uinta greenthread Determination (Alternative F)

Implementation of Alternative F may affect individuals, but is **not likely to contribute to the need for listing for any of the five species**.

Rationale for Graham's catseye, Barneby's catseye, Goodrich's blazingstar, Goodrich's columbine, and Uinta greenthread Determination (Alternative F)

Because additional habitats for Graham's catseye, Barneby's catseye, Goodrich's blazingstar, Goodrich's columbine, and Uinta greenthread exist beyond the project area, and because site-specific avoidance and minimization measures, where required by the AO, would further reduce direct or indirect impacts to individuals and habitats, project-related activities are not likely to contribute to the need for federal listing of these species.

4.12.1.6.2.4 White-tailed Prairie Dog

Impacts to the white-tailed prairie dog under Alternative F would be of the same nature as under the Proposed Action, but would affect fewer acres of occupied habitat than all of the other alternatives analyzed. Surface-disturbing activities associated with the Proposed Action (e.g., the construction of well pads, pipelines, and access roads) would result in the loss of approximately 147 discontinuous acres of prairie dog habitat in the project area, or 0.9% of the habitat present (see Table 4-111).

White-tailed Prairie Dog Determination (Alternative F)

Implementation of Alternative F may affect individuals, but is **not likely to contribute to the need to become listed.**

Rationale for White-tailed Prairie Dog Determination (Alternative F)

The rationale for this determination under Alternative F is the same as described for the Proposed Action. In addition, the amount of habitat impacted by this alternative is considerably lower than that under the Proposed Action.

4.12.1.6.2.5 Big Free-tailed Bat

Impacts to the big free-tailed bat would be of the same nature as those described under the Proposed Action. Surface-disturbing activities under Alternative F would impact 107 acres (2.7%) of potential roosting habitat, and 2,366 acres (1.8%) of potential foraging habitat (see Table 4-112). Alternative F would result in approximately 3 times more impacts to the big free-tailed bat than would occur under the No Action Alternative. Compared to the No Action Alternative, development under Alternative F would result in the disturbance of 76 more roosting acres and 825 more foraging acres of big free-tailed bat potential habitat.

Big Free-tailed Bat Determination (Alternative F)

Implementation of Alternative F may affect individuals, but is **not likely to contribute to the need to become listed.**

Rationale for Big Free-tailed Bat Determination (Alternative F)

The rationale for this determination under Alternative F is the same as that described for the Proposed Action. In addition, the amount of big free-tailed bat potential habitat impacted by this alternative would be considerably lower than under the Proposed Action.

4.12.1.6.2.6 Spotted Bat

Impacts to the spotted bat would be of the same nature as those described under the Proposed Action. Surface-disturbing activities under Alternative F would impact 107 acres (2.7%) of roosting habitat, and 3,468 acres (1.8%) of foraging habitat. Alternative F would result in approximately 3 times more impacts to roosting habitat, and almost twice as many impacts to foraging habitat than would occur under the No Action Alternative. Compared to the No Action Alternative, development under Alternative F would result in the disturbance of 76 more roosting acres and 1,535 more foraging acres of spotted bat habitat.

Spotted Bat Determination (Alternative F)

Implementation of Alternative F may affect individuals, but is **not likely to contribute to the need to become listed.**

Rationale for Spotted Bat Determination (Alternative F)

The rationale for this determination under Alternative F is the same as that described for the Proposed Action. In addition, the amount of big free-tailed bat habitat impacted by this alternative would be considerably lower than under the Proposed Action.

4.12.1.6.2.7 Burrowing Owl

Impacts to the burrowing owl under Alternative F would be of the same nature as those under the Proposed Action, but would affect fewer acres within 0.5 mile of known owl nests. Under Alternative F, 8 acres within 0.5-mile nest buffer areas would be directly converted to well pads, roads, and other facilities (see Table 4-114). In addition, surface-disturbing activities under Alternative F (e.g., the construction of well pads, pipelines, and access roads) would result in the loss of approximately 147 acres of prairie dog/burrowing owl habitat in the project area (see Table 4-111). Alternative F would result in lesser adverse impacts to the burrowing owl than would occur under the No Action Alternative. Compared to the No Action Alternative, development under Alternative F would result in the disturbance of 8 fewer acres of the owl's habitat.

Burrowing Owl Determination (Alternative F)

Implementation of Alternative F may affect individuals, but is **not likely to contribute to the need to become listed.**

Rationale for Burrowing Owl Determination (Alternative F)

Although 8 acres of burrowing owl nesting and 147 acres of prairie dog/burrowing owl habitat would be directly impacted by Alternative F, this constitutes a small percentage of suitable conservation measures would minimize direct impacts to suitable habitat and eliminate direct impacts to individual birds during the nesting season. Although Alternative F would result in direct and indirect adverse impacts to burrowing owls, the probability is relatively low based on the percentage of habitat that could be disturbed during the life of the project.

4.12.1.6.2.8 Ferruginous Hawk

Impacts to the ferruginous hawk under Alternative F would be of the same nature as those under the Proposed Action, but would affect fewer acres within 0.5 mile of known hawk nests. Under Alternative F, 258 acres (1.8%) within the 0.5-mile buffer around ferruginous hawk nesting areas would be directly converted to well pads, roads, or other facilities. In addition, the construction of well pads and roads would effectively remove 2,628 acres (or 1.8%) of potential foraging habitat from use by foraging ferruginous hawks.

Determination for Ferruginous Hawk (Alternative F)

Implementation of Alternative F **may affect individuals, but is not likely to contribute to the need to become listed.**

Rationale for Ferruginous Hawk Determination (Alternative F)

Although 2,628 acres of foraging habitat and 258 acres of nesting habitat would be directly impacted by Alternative F, this constitutes a small percentage of suitable habitat available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat, and eliminate direct impacts to individual birds during the nesting season. While Alternative F could potentially result in direct and indirect adverse impacts to ferruginous hawks, the probability is relatively low based on the percentage of habitat that could be disturbed during the life of the project.

4.12.1.6.2.9 Bald Eagle

There would be no direct impacts to bald eagles under the Alternative F. No impacts to wintering bald eagles due to long-term surface disturbance, fragmentation, and human-disturbance of winter roosting habitat within 0.5 mile of known winter roosting areas are planned for this alternative. In addition, no acres of all potential roosting habitat (riparian) in the project area would be disturbed. Road-associated impacts described under the Proposed Action would occur along approximately 198 miles of new roads in the project area under Alternative F.

Bald Eagle Determination (Alternative F)

Implementation of Alternative F is not expected to affect individuals, and is **not likely to contribute to the need to become listed.**

Rationale for Bald Eagle Determination (Alternative F)

No impacts within 0.5 mile of known bald eagle winter roosting areas would be directly impacted by Alternative F. In addition, no impacts are expected within potential roosting habitat located in riparian areas under Alternative F.

4.12.1.6.2.10 Golden Eagle

Short- and long-term direct and indirect impacts of well development on golden eagles are identical to those described in Section 4.12.1.1.3.1, Raptors. All applicant-committed measures will be followed as stated in Section 2.2.9.6.

Surface-disturbing activities under Alternative F would impact 224 acres of nest buffer area. Temporal and spatial buffers apply to this nest buffer area, and would be prescribed during site-specific surveys. The activity of the affected nests would also be determined during site-specific surveys. Alternative F would result in slightly more impacts to the golden eagle than would occur under the No Action Alternative. Compared to the No Action Alternative, development under Alternative F would result in the disturbance of 83 more acres of nest buffer area. However, the disturbance of this nest buffer area is negligible due to applicant-committed measures and BMPs.

Golden Eagle Determination (Alternative F)

Implementation of Alternative F may affect individuals, but is **not likely to contribute to the need to become listed.**

Rationale for Golden Eagle Determination (Alternative F)

Although 224 acres within 0.5 mile of a known golden eagle nest would be directly impacted by Alternative F, this constitutes a small percentage of suitable habitat available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat and eliminate direct impacts to individual birds during the nesting season. Although Alternative F could potentially result in direct and indirect adverse impacts to golden eagles, the probability is relatively low based on number of nests that could be disturbed during the life of the project.

4.12.1.6.2.11 Short-eared Owl

Impacts to the short-eared owl under Alternative F would be of the same nature as those under the Proposed Action, but would affect fewer acres within the owl's potential habitat. Under Alternative F, approximately 2,178 acres of well pads and roads would be constructed in short-eared owl habitat, rendering 1.8% of this area unusable to owls for the life of the project (see Table 4-118).

Short-eared Owl Determination (Alternative F)

Implementation of Alternative F may affect individuals, but is **not likely to contribute to the need to become listed.**

Rationale for Short-eared Owl Determination (Alternative F)

Although 2,178 acres of potential short-eared owl habitat would be directly impacted by Alternative F, this constitutes a small percentage of such habitats available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat and eliminate direct impacts to individual birds during the nesting season. Although Alternative F could potentially result in direct and indirect adverse impacts to short-eared owls, the probability is relatively low based on the percentage of habitat that could be disturbed during the life of the project. Based on this analysis, conservation measures, and applicant-committed measures, the BLM has determined that Alternative F would not likely contribute to the need for federal listing.

4.12.1.6.2.12 Lewis' Woodpecker

Impacts to the Lewis' woodpecker would be of the same nature as those described under the Proposed Action. Surface-disturbing activities under Alternative F would impact 706 acres (1.7%) of Lewis' woodpecker habitat. Alternative F would disturb 419 more acres of Lewis' woodpecker habitat than would the No Action Alternative.

Lewis' Woodpecker Determination (Alternative F)

Implementation of Alternative F may affect individuals, but is **not likely to contribute to the need to become listed.**

Rationale for Lewis' Woodpecker Determination (Alternative F)

Although 706 acres of potential Lewis' woodpecker habitat would be directly impacted by Alternative F, this constitutes a small percentage of such habitats available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat and eliminate direct impacts to individual birds during the nesting season. Although Alternative F could potentially result in direct and indirect adverse impacts to Lewis' woodpecker, the probability is relatively low based on the percentage of habitat that could be disturbed during the life of the project.

4.12.1.6.2.13 Mountain Plover

Impacts to the mountain plover would be similar to those described under the Proposed Action. Surface-disturbing activities under Alternative F would impact 236 acres of mountain plover known breeding habitat (1.0%). Alternative F would result in a lesser impact to mountain plover known breeding habitat than would occur under the No Action Alternative. Compared to the No Action Alternative, development under Alternative F would result in the disturbance of 263 fewer acres of known breeding habitat (see Table 4-120).

Mountain Plover Determination (Alternative F)

Implementation of the Alternative F may impact individuals, but is **not likely to contribute to the need to become listed**.

Rationale for Mountain Plover (Alternative F)

Although 236 acres of potential mountain plover habitat would be directly impacted by Alternative F, this constitutes a small percentage of such habitats available both within the project area and throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat, and eliminate direct impacts to individual birds during the nesting season.

4.12.1.6.2.14 Sensitive Fish Species

Impacts to roundtail chub, bluehead sucker, and flannelmouth sucker would be the same as the impacts to federally listed Colorado River fish, as described in Section 4.12.1.2.1.11.

Colorado River Sensitive Fish Determinations (Alternative F)

Implementation of Alternative F may affect individuals, but is **not likely to contribute to the need to become listed**.

Colorado River Sensitive Fish Determination Rational (Alternative F)

The rationale for the determination above is the same as described for the Proposed Action.

4.12.1.6.3 Other Special Status Species Retained for Analysis

4.12.1.6.3.1 Raptors

Under Alternative F, 779 acres of surface disturbance would occur within 0.5-mile of raptor nests. This represents 2.1% of the total raptor nesting buffer in the project area (see Table 4-122).

Road-related disturbance to raptors would result from the construction of 44 miles of new roads within 0.5-mile of raptor nests under the Alternative F (see Table 4-122). This is a 33% increase over current conditions.

Raptor Determination (Alternative F)

The implementation of Alternative F may affect individuals, but is **not likely to contribute to the need to become listed.**

Rationale for Raptor Determination (Alternative F)

Although 779 acres of raptor nesting habitat would be directly impacted by Alternative F, this constitutes a small percentage of such habitats available throughout the range for this species. Applicant-committed measures and conservation measures would minimize direct impacts to suitable habitat and eliminate direct impacts to individual birds during the nesting season. Although Alternative F could potentially result in direct and indirect adverse impacts to raptor nesting habitat, the probability is relatively low based on the percentage of habitat that could be disturbed during the life of the project.

4.12.1.6.3.2 Migratory Birds

A total of approximately 3,601 acres of surface disturbance would occur on land within migratory bird habitat under Alternative F. This represents approximately 1.74% of total migratory bird habitat in the project area (see Table 4-124).

Road-related disturbance to migratory birds would result from the construction of 198 miles of new roads under Alternative F. This represents a 35% increase over current conditions, and 175% greater road-related disturbance than the No Action Alternative. Under the Proposed Action, there would be an estimated 4.5% maximum increase in traffic volume over current conditions (see Section 4.5, Table 4-75). The construction of new roads would also have indirect impacts associated with habitat fragmentation (discussed in detail in Section 4.16.1.1.7) and noise disturbances.

Under Alternative F, 75% (155,017 acres) of the total migratory bird habitat in the project area would lose functional value due to fragmentation. This is an 18% increase in unfavorable habitat over current conditions (59% of total migratory bird habitat in the project area is currently unfavorable due to fragmentation), and a 5% increase over the No Action Alternative (see Table 4-124).

Migratory Birds Determination (Alternative F)

The implementation of Alternative F may affect individuals, but is **not likely to contribute to the need to become listed**.

Rationale for Migratory Birds Determination (Alternative F)

None of the migratory birds considered are proposed for listing under the ESA or included on the BLM sensitive species list. Although impacts in the project area could adversely affect local populations or individuals, a relatively small percentage of each species' habitat within their entire range would be impacted by the Proposed Action. In addition, no more than 1.8% of each species' habitat in the project area would be directly impacted (Table 4-123) under Alternative F. Based on this analysis, the BLM has determined that Alternative F would not contribute to the need for federal listing of any of these migratory bird species.

4.12.2 Mitigation Measures

In addition to the applicant-committed measures detailed in Section 2.2.9 there are several proposed conservation measures that could be used to reduce expected impacts to special status plant, bird, wildlife, and fish species. These proposed measures are detailed in the subsections below.

4.12.2.1 Mitigation Measures for Special Status Plants

In addition to the applicant-committed conservation measures described in Appendix B, the following mitigation measures could be used to reduce adverse impact to special status plants:

- Herbicides would not be applied in a manner that could lead to inadvertent adverse impacts to special status plants. All herbicide application would be coordinated with the AO (and USFWS when threatened and endangered plants are involved) to ensure that special status plants were not impacted. These measures would be determined on a site-specific basis, but would include: 1) applying herbicides only when wind speed is below 7 mph to avoid drift; 2) following buffer distances for each specific herbicide as listed in the Vegetation Treatments Using Herbicides on Bureau of Land Management Lands in 17 Western States Programmatic EIS (BLM 2005e), Volume I, pages 4-54 and 61, and specifying application methods.
- Conservation measures described in Appendix B for federally listed plants would be applied to sensitive plant species, except that there would be a 150-foot buffer for survey and avoidance areas.
- Population density surveys would be conducted within suitable habitat to facilitate avoidance of important population centers and identify prime suitable habitat for recovery.
- A pre-project weed inventory would be conducted before ground disturbing activities.
- All vehicles entering the project area from outside the Uinta Basin would be power washed to remove seed and plant materials. An environmental inspector would inspect each vehicle and place a sticker on them to verify they came in clean.
- Invasive plant weed inventories would be conducted annually in all disturbed areas.
- Invasive plant control measures (mechanical, cultural, chemical) would be conducted before seed set each year. Some populations may require more than one treatment per year. Manual pulling around threatened and endangered species would be done as necessary and as directed by the AO.
- All areas not used for the operational phase of the project would be reseeded (to provide noxious weed control).
- Suitable habitat for the shrubby reed-mustard that falls within 500 feet of any area to be disturbed would be inventoried for weeds, and a treatment plan would be developed and initiated as the discretion of the AO. The treatment would be designed to treat existing weed infestations and avoid their further spread due to project-related surface disturbance.
- When the new Pariette and Uinta Basin Hookless cactus core conservation areas and management for those areas are finalized, in accordance with the cactus conservation measures (Appendix B), additional measures to avoid or minimize effects to the species may be developed and implemented in consultation with the USFWS to ensure compliance with the ESA.

- Dust palliatives (other than gravel and water) would be used at the direction of the AO.
- All applicable Fluid Minerals BMPs from Appendix R of the Vernal RMP (BLM 2008c) would be implemented.

4.12.2.2 Mitigation Measures for the Western Yellow-billed Cuckoo

Wells proposed within the Green River's 100-year floodplain would be relocated to non-floodplain areas or drilled directionally from beyond the floodplain to avoid disturbance of riparian habitat suitable to the WYBC.

4.12.2.3 Mitigation Measures for Raptors, including the Bald Eagle, Golden Eagle, Mexican Spotted Owl, Burrowing Owl, Ferruginous Hawk, and Short-eared Owl

- Project-related development in areas directly associated with raptor nests area would be guided by the use of *Best Management Practices for Raptors and Their Associated Habitats in Utah* (Appendix A in BLM 2008c), utilizing seasonal and spatial buffers, as well as mitigation, to maintain and enhance raptor nesting and foraging habitat, while allowing other resource uses.
- Well pads, roads, and other facilities would be located in a manner to conceal them from raptor nests (active or inactive) by using topographic and vegetative screening features.
- Birds would be excluded from evaporative facilities through the use of properly installed netting or other deterrents identified by the AO.
- All applicable Fluid Minerals BMPs from Appendix R of the Vernal RMP (BLM 2008c) would be implemented.

4.12.2.3.1 Mitigation Measures Specific to Ferruginous Hawk

- Between March 1 and July 15, new construction or surface-disturbing activities would be avoided within a 0.5-mile buffer of inactive ferruginous hawk nests that have been active within the past 2 years, subject to the following restrictions:
- Wells proposed within 0.5 mile of inactive nests would either be equipped with multi-cylinder engines or muffled to reduce noise levels;
- Gasco employees would be trained to identify ferruginous hawks and golden eagles, instructed to avoid disturbance of active nests, and required to stay within or near vehicles to prevent flushing when birds are present.

4.12.2.3.2 Mitigation Measures Specific to Bald Eagle

- Construction or surface-disturbing activities would be avoided within 0.5 mile of known bald eagle winter concentration areas and winter night roost sites from November 1 through March 31. Daily activities that must occur within the recommended spatial buffers at winter night roosts sites would be scheduled between 9:00 a.m. and 1 hour prior to the official sunset. These measures would be implemented on a site-by-site basis in coordination with the BLM.

4.12.2.3.3 Mitigation Measures Specific to Mexican Spotted Owl

- Where technically and economically feasible, directional drilling, including drilling multiple wells from the same pad, would be used to reduce surface disturbance and eliminate drilling in "Fair" or "Good" habitat for MSO nesting.
- For all temporary actions that may impact owls or "Fair" or "Good" habitat:
    - If the action occurs entirely outside the owl breeding season (March 1–August 31), and leaves no permanent structure or permanent habitat disturbance, the action can proceed without an occupancy survey.
    - If the action will occur during a breeding season, surveys for owls will occur prior to the commencement of the activity in accordance with USFWS survey protocol for the species. If owls are found, the activity must be delayed until outside of the breeding season.
    - Rehabilitate access routes created by the project through such means as raking out scars, re-vegetation, gating access points, etc.
- For all permanent actions that may impact owls or "Good" or "Fair" habitat:
    - Survey 2 consecutive years for owls according to the USFWS survey protocol for the species prior to commencing activities. If owls are found, no actions will occur within 0.5 mile of an identified nest site. If the nest site is unknown, no activity will occur within the designated Protected Activity Center.
    - Avoid drilling and permanent structures within 0.5 mile of "Fair" or "Good" habitat unless it is determined, based on the surveys, that the habitat is not occupied.
    - Reduce noise emissions (e.g., use hospital-grade mufflers) to 45 dBA at 0.5 mile from "Fair" or "Good" habitat. Siting of permanent noise-generating facilities would be determined based on a noise analysis to ensure noise does not encroach upon the 0.5 mile buffer for "Fair" or "Good" habitat.
    - Stay on approved routes and limit new access routes.

4.12.2.4 Mitigation Measures for Migratory Birds

- As directed by the AO, breeding bird surveys would be conducted by a qualified biologist within 660 feet (200 m) of proposed surface-disturbing activities associated with well development (e.g., well pads, roads, pipelines, and ancillary facilities) that would occur during the breeding season (April 1–July 31). The biologist would provide documentation of active nests, bird species, and other evidence of nesting (e.g., mated pairs, territorial defense, birds carrying nesting material, transportation of food) to the BLM following each survey and prior to surface-disturbing activities.
- Coordination with the BLM would take place if an active nest for Important Migratory Bird Species (e.g., the USFWS Birds of Conservation Concern [BCC], Partners in Flight [PIF] Priority Bird Species, Utah Sensitive Species) is documented during the survey. This would be done to determine if any additional protection measures would be required. Applicable and appropriate protection measures, including establishment of buffers areas and constraint periods, would be implemented on a case-by-case and species-specific basis.

- Elevation of surface pipelines (4 inches or greater in diameter) on level or gently sloping ground (5% slope or less) to a minimum of 6 inches above the ground to allow passage beneath the pipe would take place. This ground clearance would be achieved by placing the pipeline on blocks at intervals of 150–200 feet.
- The installation of noise-reduction devices (e.g., mufflers) on all pump jacks to reduce intermittent noise to 45 dBA at 660 feet (200 m) from the source would be required.
- The proper installation of netting or other deterrents as directed by AO would be required to exclude birds from evaporative facilities.

4.12.2.5 Mitigation Measures for Greater Sage-grouse

- Surface disturbing activities, including blading and grading of well pads, roads, and pipeline corridors within sagebrush-steppe habitat would be conducted prior to and after sage-grouse breeding season (March 1–June 30) in order to avoid direct impacts on sage-grouse nests.
- No surface disturbance would take place within a 0.25-mile buffer, and the season nesting buffer would extend 2 miles from any active lek.
- The use of low-profile tanks would be used within 2 miles of active leks as appropriate given the topography and as directed by the AO.
- Workover visits would be limited to the hours between 9:00 a.m. and 5:00 p.m. during breeding season within 2 miles of active leks.
- The best available technology, such as installation of multicylinder pumps, hospital sound reducing mufflers, and placement of exhaust systems to reduce noise, would be used within 0.5 mile of known active leks.
- Permanent facilities or structures would be avoided within 2 miles of sage-grouse leks when possible.

4.12.2.6 Mitigation Measures for Colorado River System Endangered and Sensitive Fish

- Gasco and its contractors would locate, handle, and store hazardous substances in locations that would prevent accidental spill or delivery to the Green River or its tributaries.
- Pipelines containing natural-gas condensate would not cross Nine Mile Creek at any point.
- Natural gas-condensate pipelines that cross the Federal Emergency Management Agency (FEMA)-mapped 100-year floodplain, mapped riparian, or wetland areas would be routinely pigged and would have emergency shutoff valves located immediately outside the floodplain.
- Natural gas pipelines that cross perennial, intermittent, and ephemeral stream channels would either be elevated above the predicted 100-year flood event on a pipe bridge, or buried below the predicted scour depth for an equivalent flood event. The construction requirements for each type of crossing would be determined on a site-specific basis, and would consider the technical guidance of the document entitled, “Hydraulic Considerations for Pipeline Crossings of Stream Crossings,” contained as Appendix B of the Vernal RMP (BLM 2008c).

- Natural gas pipelines that cross perennial, intermittent, and ephemeral stream channels would have automatic shutoff valves directly beyond the area at risk of flooding to reduce the magnitude of contamination in the event of an accidental pipeline break.
- Natural gas pipelines that cross perennial, intermittent, and ephemeral stream channels would be buried at least 5 feet below the channel bottom.
- Wells with the potential to contaminate surface waters would have automatic shutoff valves.
- Wells proposed within the Green River's 100-year floodplain would be relocated to non-floodplain areas or drilled directionally from beyond the floodplain.
- Wells proposed in all 100-year floodplains within 5 miles of the Green River would use measures including the use of closed-loop drilling methods, berming and secondary containment of all tanks and pits, and drilling during non-flood prone seasons.
- All applicable BLM-committed Conservation Measures for Colorado River fishes, as described in Appendix L of the Vernal RMP (BLM 2008c), would be used as needed to mitigate potential impacts to endangered and sensitive fishes and their habitat.
- To avoid entrainment, water would be pumped from an off-channel location—one that does not connect to the river during high spring flows. An infiltration gallery constructed in a location approved by USFWS would be best.
- If the pump head is located in the river channel the following stipulations would apply:
    - the pump would not be situated in a low-flow or no-flow area as these habitats tend to concentrate larval fishes.
    - the amount of pumping would be limited, to the greatest extent possible, during that period of the year when larval fish may be present (see above).
    - the amount of pumping would be limited, to the greatest extent possible, during the midnight hours (10pm to 2 am), as larval drift studies indicate that this is a period of greatest daily activity. Dusk is the preferred pumping time, as larval drift abundance is lowest during this time.
- All pump intakes would be screened with 3/32” mesh material.
- Approach velocities for intake structures would follow the National Marine Fisheries Service's document “Fish Screening Criteria for Anadromous Salmonids.” For projects with an in-stream intake that operate in stream reaches where larval fish may be present, the approach velocity would not exceed 0.33 feet per second (ft/s).
- Any fish impinged on the intake screen or entrained into irrigation canals would be reported to the U.S. Fish and Wildlife Service (801.975.3330) or the Utah Division of Wildlife Resources Northeastern Region, located at 152 East 100 North, Vernal, UT 84078 (435.781.9453).

4.12.2.7 Mitigation Measures for Bats

- The proper installation of netting or other deterrents as directed by AO would be required to exclude bats from evaporative facilities (or reserve pits, as needed).

4.12.2.8 Mitigation Measures for White-tailed Prairie Dog

- No surface-disturbing activities or permanent aboveground facilities would be allowed within 660 feet of prairie dog colonies unless the impacts of the action can be adequately mitigated or, if due to the size of the town, there is no reasonable location to develop a lease and avoid colonies.

4.12.3 Unavoidable Adverse Impacts

Adverse impacts to special status species from the Gasco Energy Field Development that could not be mitigated include the following:

- Long-term losses of potential habitat useful for the survival or recovery of special status plants, birds, and wildlife.
- Long-term losses of raptor breeding, nesting, and foraging habitats.
- Long-term losses of potential raptor breeding, nesting, and foraging habitats.
- Fragmentation of special status wildlife, bird, and plant habitat by well pads, pipelines, roads, and ancillary features. Reduction in size of contiguous roadless habitat areas.
- Water depletion from the Colorado River Basin resulting in adverse impacts to Colorado River endangered and sensitive fish species.

4.12.4 Irretrievable and Irreversible Commitments of Resources

Any losses of potential habitat useful for the survival or recovery of special status plants, birds, and wildlife would be irretrievable until disturbed areas were actively and adequately restored. The fragmentation of special status wildlife, bird, and plant habitat from well pads, pipelines, roads, and ancillary features would be irretrievable until these features were removed and reclaimed following project completion. The increased spread of invasive weeds into the habitat of special status species would be either irretrievable or irreversible, depending on the success of weed eradication efforts. Impacts related to the depletion of flows in the Green River would be an irreversible impact. Where the alteration of plant habitat cannot be reclaimed, such as the disturbance of biological soil crusts or other soils required by special status plants, these impacts would be irreversible as well.

4.12.5 Relationship of Short-term Uses to Long-term Productivity

Construction of roads, well pads, pipelines, and ancillary facilities would provide a short-term use that would result in long-term loss and fragmentation of special status species habitat. Noxious weed invasion into the habitat of special status plant and animal species would also be a long-term effect of the construction and project-related activities, and could affect the long-term productivity of habitats that are invaded. Indirect effects from OHVs, sedimentation, and wildfire would also have long-term negative impacts on the habitat suitability of special status species in the project area.

4.13 VEGETATION

Direct effects to vegetation include the disturbance and removal of vegetation during construction of well pads, roads, pipelines, evaporation facilities, and other ancillary facilities, as well as accidental spills of fuels, lubricants, and/or other materials harmful to vegetation. The duration of these impacts could range from short- to long-term. Short-term impacts would occur in areas where previously vegetated locations are disturbed but successfully reclaimed within five years. Long-term direct effects would occur where well pads, roads, or other semi-permanent facilities displace previously vegetated areas for more than five years. Due to the difficultly of successfully restoring vegetation in the project area however, all impacts to vegetation are considered long-term impacts in the following analysis.

Indirect effects to vegetation would occur as a result of activities other than direct disturbance or removal of vegetation. Sources of indirect effects would include the introduction or spread of noxious weeds; increased public access and associated vegetation trampling/harvest; fugitive dust; and increased risk of human-caused wildfire. Changes in vegetation community composition following rehabilitation are also potential long-term effects of vegetation removal and disturbance. Long-term indirect effects could persist well beyond the timescale of project operations in areas where soil features restrict the effectiveness of rehabilitation efforts, such as in sodic, alkaline, shallow, and erosion-prone soils (see Section 4.10, Soils).

Initial losses of vegetation would be followed by a greater potential for invasive and noxious weed establishment and decreased vegetative productivity. Successful reclamation is estimated to take as much as 10 years, during which time the disturbed site would be more susceptible to erosion and weed infestation that would require ongoing mitigation. Revegetation is especially difficult with the desert shrub type, which often occurs in areas with shallow and highly saline soils, and where moisture availability is relatively low. Invasion by non-native plants, notably cheatgrass, is likely in the sagebrush/perennial grass types, particularly where disturbed or grazed heavily by domestic livestock. Pinyon-juniper woodland areas that have been chained and/or burned in the past are also highly susceptible to weed invasions, and further disturbance would only increase the possibility of weed infestation. Surface disturbance near weed populations in these areas would likely allow for the weeds to spread.

4.13.1 DIRECT AND INDIRECT EFFECTS

4.13.1.1 ALTERNATIVE A: PROPOSED ACTION

4.13.1.1.1 IMPACTS TO VEGETATION COMMUNITIES

Alternative A (Proposed Action) would directly impact approximately 7,584 acres of vegetation through either disturbance or removal during the construction of well pads, roads, pipelines, evaporative ponds, and other ancillary facilities. The impacts to each of the National Land Cover Database (NLCD) land cover types identified in the project area (Section 3.13, Vegetation) are shown in Table 4-125. Data presented for each land-cover type include the total acreage impacted, and the percentage of the land cover type impacted in the project area.

Table 4-125. Acres of Direct Disturbance of each NLCD Vegetation Type Present in the Project Area and Percentage of Each Type Disturbed

National Land Cover Class	National Land Cover Description	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Scrub/shrub	Colorado Plateau Mixed Low Sagebrush Shrubland	2,466 (4.4%)	1,668 (2.9%)	2,703 (4.8%)	506 (0.9%)	623 (1.1%)	1,166 (2.1%)
	Colorado Plateau Pinyon-Juniper Shrubland	219 (2.3%)	155 (1.6%)	397 (4.1%)	88 (0.9%)	63 (0.6%)	130 (1.3%)
	Inter-mountain Basins Big Sagebrush Shrubland	464 (3.5%)	357 (2.7%)	740 (5.6%)	140 (1.1%)	115 (0.9%)	280 (2.1%)
	Inter-mountain Basins Mat Saltbush Shrubland	29 (2.8%)	29 (2.7%)	49 (4.6%)	13 (1.2%)	10 (0.9%)	9 (0.9%)
	Inter-mountain Basins Mixed Salt Desert Scrub	1,700 (4.4%)	1,285 (3.3%)	2,334 (6.1%)	681 (1.8%)	558 (1.5%)	580 (1.5%)
	Rocky Mountain Gambel Oak-Mixed Montane Shrubland	0 (0%)	0 (0%)	1 (11.7%)	0 (0%)	0 (0%)	0 (0%)
Total scrub/shrub		4,879 (4.1%)	3,494 (2.9%)	6,224 (5.2%)	1,428 (1.2%)	1,369 (1.1%)	2,165 (1.8%)
Evergreen forest	Colorado Plateau Pinyon-Juniper Woodland	924 (3.1%)	820 (2.7%)	1,320 (4.4%)	190 (0.6%)	63 (0.2%)	576 (1.9%)
	Rocky Mountain Montane Dry-Mesic Mixed Conifer Forest and Woodland	2 (0.7%)	1 (0.5%)	10 (3.5%)	0 (0%)	1 (0.5%)	0 (0.0%)
	Rocky Mountain Montane Mesic Mixed Conifer Forest and Woodland	0 (0.0%)	0 (0.0%)	2 (4.2%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Total evergreen forest		926 (3.0%)	821 (2.7%)	1,332 (4.4%)	190 (0.6%)	64 (0.2%)	576 (1.9%)

Table 4-125. Acres of Direct Disturbance of each NLCD Vegetation Type Present in the Project Area and Percentage of Each Type Disturbed

National Land Cover Class	National Land Cover Description	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Barren lands	Colorado Plateau Mixed Bedrock Canyon and Tableland	478 (2.0%)	370 (1.6%)	871 (3.7%)	115 (0.5%)	131 (0.6%)	289 (1.2%)
	Inter-mountain Basins Shale Badland	23 (1.2%)	17 (0.9%)	56 (2.9%)	6 (0.3%)	6 (0.3%)	1 (0.1%)
	Rocky Mountain Cliff and Canyon	156 (3.9%)	119 (3.0%)	163 (4.1%)	31 (0.8%)	46 (1.2%)	107 (2.7%)
Total barren lands		657 (2.2%)	506 (1.7%)	1,090 (3.7%)	152 (0.5%)	183 (0.6%)	397 (1.3%)
Grasslands/ herbaceous	Inter-mountain Basins Montane Sagebrush Steppe	98 (6.8%)	98 (6.8%)	93 (6.4%)	5 (0.4%)	38 (2.6%)	63 (4.4%)
	Inter-mountain Basins Semi-Desert Grassland	101 (5.0%)	84 (4.2%)	90 (4.5%)	21 (1.0%)	33 (1.6%)	47 (2.3%)
	Inter-mountain Basins Semi-Desert Shrub Steppe	358 (3.5%)	308 (3.0%)	507 (4.9%)	99 (1.0%)	123 (1.2%)	170 (1.6%)
	Southern Rocky Mountain Montane-Subalpine Grassland	33 (4.1%)	33 (4.1%)	40 (5.0%)	9 (1.1%)	16 (2.0%)	29 (3.6%)
Total grasslands/herbaceous		591 (4.1%)	523 (3.6%)	730 (5.0%)	134 (0.9%)	210 (1.4%)	309 (2.1%)
Woody wetland	Inter-mountain Basins Greasewood Flat	292 (4.7%)	188 (3.1%)	339 (5.5%)	85 (1.4%)	59 (1.0%)	98 (2.1%)
	Rocky Mountain Lower Montane Riparian Woodland and Shrubland	29 (2.4%)	19 (1.6%)	9 (0.8%)	8 (0.7%)	6 (0.5%)	0 (0.0%)
Total woody wetland		321 (4.4%)	207 (2.8%)	348 (4.7%)	93 (1.3%)	65 (0.9%)	98 (1.3%)

Table 4-125. Acres of Direct Disturbance of each NLCD Vegetation Type Present in the Project Area and Percentage of Each Type Disturbed

National Land Cover Class	National Land Cover Description	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Disturbed and agricultural land	Disturbed, Oil Well	0 (0.0%)	0 (0.0%)	5 (20.5%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
	Invasive Annual Grassland	196 (4.5%)	124 (2.8%)	240 (5.5%)	53 (1.2%)	41 (0.9%)	56 (1.3%)
	Invasive Southwest Riparian Woodland and Shrubland*	8 (1.6%)	4 (0.8%)	7 (1.5%)	2 (0.5%)	2 (0.3%)	0 (0.0%)
	Agriculture	0 (0%)	0 (0.0%)	1 (0.9%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Total disturbed land		204 (4.0%)	128 (2.5%)	253 (5.0%)	54 (1.1%)	43 (0.8%)	56 (0.0%)
Total vegetation disturbed		7,584	5,679	9,977	2,051	2,173	3,601

**Note:* This reflects impacts as analyzed using remotely sensed (SWreGAP) vegetation data. Impacts to BLM-identified riparian zones are discussed in Section 4.15

Scrub/shrub vegetation types would be the most commonly disturbed under the Proposed Action, with the most acres impacted in the Colorado Plateau Mixed Low Sagebrush Shrubland (2,466 acres) and Inter-mountain Basins Mixed Salt Desert Scrub (1,700 acres) (see Table 4-125). However, other vegetation types would have a greater percentage of their acreage in the project area that would be disturbed. By this measure, communities of Inter-mountain Basins Greasewood Flat (4.7%), Montane Sagebrush Steppe (6.8%), Semi-Desert Grassland (5.0%), and Mixed Salt Desert Scrub (4.4%) would be the most highly impacted by the proposed development.

Development under the Proposed Action would directly impact approximately 3.7 times the area of vegetation as would occur under the No Action Alternative. Several community types would be impacted at a far higher rate relative to impacts under the No Action Alternative, however. Approximately 19 times more Inter-mountain Basins Montane Sagebrush Steppe and 5 times more Rocky Mountain Cliff and Canyon would be disturbed. Impacts to riparian zones are discussed in Section 4.15, Water Resources.

4.13.1.1.2 Noxious and Invasive Weeds

Areas disturbed under the Proposed Action and adjacent areas would be adversely impacted due to an increased risk of noxious and invasive weed establishment. Many invasive plants are adapted to quickly spread through disturbed ecosystems, producing changes in native vegetation communities. Specific negative effects of noxious and invasive weeds can include

- reduction in the overall visual character of an area,
- competition with or elimination of native plant communities,
- reduction or fragmentation of wildlife habitats and forage, and
- increased soil erosion.

Construction activities, increased soil disturbance, and higher traffic volumes enhance the risk of the introduction and spread of existing and new weed species in the project area.

Unknown levels of weed infestation already occur on previously disturbed areas in the project area (the NLCD classifies 4,859 acres of the project area as dominated by invasive species; see Table 3-27), and along existing roads leading into it. As such, travel through these areas could lead to the transport of weed seeds throughout the project area. Similarly, pull-offs onto road edges with equipment and vehicles, or parking on disturbed areas en route to the project area could result in vehicle tires and undercarriages transporting weed seeds to undisturbed locations. The area at risk for weed invasion is at least equal to the 7,584 acres of vegetation disturbed under the Proposed Action, because these areas would be highly disturbed and devoid of vegetation prior to being reclaimed following production and abandonment. However, because project-related disturbance would likely lead to the establishment of invasive species along disturbance corridors, the area impacted by weeds could become larger than the disturbed area, as these species invade undisturbed areas.

The expansion of road networks has been documented to contribute to exotic plant invasions via introduced roadfill, vehicle transport, and road maintenance activities (Forman and Alexander 1998; Gelbard and Belnap 2003; Knick et al. 2003). Invasive species are not limited to roadsides, but have also encroached into the surrounding habitats (Forman and Alexander 1998; Gelbard and Belnap 2003). In their study of roads on the Colorado Plateau of southern Utah, Gelbard and

Belnap (2003) found that improving unpaved four-wheel-drive roads resulted in increased cover of exotic plant species within the interior of adjacent vegetative communities. This effect was associated with road construction, maintenance activities, and vehicle traffic.

Cheatgrass (*Bromus tectorum*) is an invasive grass with a high potential to spread from disturbed areas (Gelbard and Belnap 2003). Bradley and Mustard (2006) found an increased probability of cheatgrass within approximately 2,500 feet of roads in a study in the Great Basin, with up to approximately 13% greater probability of cheatgrass occurrence within 200 feet of roads. Assuming a 200-foot buffer from all new project-related roads in the project area, approximately 15,757 acres (or 7% of the project area) would have an elevated risk of cheatgrass invasion (Table 4-126), in addition to the 7,584 acres directly disturbed by roads, pipelines, and other infrastructure. However, applicant-committed measures to inventory and treat all noxious weeds in and adjacent to areas disturbed by project activities would greatly reduce this risk.

Table 4-126. Length of New Road and Acres with Increased Risk of Invasive Weeds under Each Alternative*

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Length of new roads (miles)	325	274	526	72	106	198
Acres with increased risk of cheatgrass establishment[1]	15,757	13,285	25,503	3,491	5,139	9,600
Acres with increased risk of halogeton and Russian Thistle establishment[2]	1,812	1,528	2,933	401	591	1,104

[1]Assumes a 200-foot width with increased risk of cheatgrass establishment on both sides of all new roads.

[2]Assumes a 23-foot width with increased risk of halogeton and Russian thistle establishment on both sides of all new roads.

* Risk prior to the implementation of applicant-committed measures to treat noxious weeds along all constructed roads and other disturbance areas.

Weeds common to the project area with a lesser potential to spread (Gelbard and Belnap 2003) such as halogeton (*Halogeton glomeratus*) and Russian thistle *(Salsola tragus)*, would be less likely to invade large areas. However, they would be a widespread impact close to areas of surface disturbance. Gelbard and Belnap (2003) observed 3 times denser cover of halogeton and Russian thistle in disturbance areas (or "verges") surrounding improved and graded roads in Canyonlands National Park. Based on their research, and assuming an average verge width of approximately 23 feet from roads, approximately 1,812 acres (or 0.8% of the project area) would be susceptible to invasion by halogeton, Russian thistle, and other species (see Table 4-126), in addition to the 7,584 acres directly disturbed by roads, pipelines, and other infrastructure. Compared to the No Action Alternative, road and well-pad development under the Proposed Action would result in an increased risk of weed invasion over approximately 4.5 times as large an area.

4.13.1.1.3 Other Impacts

Additional impacts of well and road development on vegetation include the delivery of dust onto nearby vegetation from project-related traffic, an increased risk of accidental spills onto vegetation, impacts to both the incidence and control of wildfire, and increased vehicle access to areas adjacent to project roadways. The longevity of these impacts depends on the longevity of the constructed roadways. Decommissioning roads following termination of well production would limit impacts to the duration of project operations; roads that remained accessible following production would prolong these impacts.

No data are available on the distribution of dust that would be generated by roads as a result of the Proposed Action. However, because dust can reduce photosynthesis and productivity in desert plants (Sharifi et al. 1997), it would have a negative impact of unknown magnitude and spatial extent on plants in the project area. The Proposed Action would include 325 miles of new roadways in the project area, so it is assumed that dust impacts would be greater than under Alternative B, Alternative E, and the No Action Alternative, but fewer than under Alternative C (see Table 4-126). Similarly, the increased risk of spills of materials potentially harmful to vegetation is most likely along roads and pipelines. In addition to the roads above, the Proposed Action would include 431 miles of new pipelines. Therefore, it is assumed that the risk of spills would be greater than under Alternative B and the No Action Alternative, but the risk would be less than under Alternative C. Due to containment berms and leak-detection systems, the risk of spills from the evaporative facility that would affect vegetation is very low.

Data on the effects of road and well development on wildfire frequency and magnitude are not available for this area. It is assumed that the frequency of wildfires would increase because of elevated human access and activity in the project area. The Proposed Action would result in the disturbance and repeated use of approximately 7,584 acres, which would increase the risk of human-caused wildfire starts over this area. Conversely, it is assumed that the severity of wildfires may decrease because of the enhanced road access for fire suppression personnel. Approximately 325 miles of new road would be constructed under this alternative, which would increase access by firefighting equipment and personnel over its length. Because 80% of wildfires on BLM-administered lands are caused by lightning, the increased access for firefighting may decrease the fire risk more than additional human access would increase it (BLM 2005c).

Roadway construction under the Proposed Action would also increase access to the project area by passenger vehicles and OHVs; approximately 4.5 times as many miles of new roads would be constructed under the Proposed Action as opposed to the No Action Alternative. The larger road network created by the Proposed Action would have an adverse impact (of unknown magnitude) on surrounding vegetation communities due to increased OHV use and associated trampling.

4.13.1.2 Alternative B: Reduced Development

Direct and indirect impacts for this alternative would be similar to those under the Proposed Action, but would affect fewer acres. Construction under Alternative B would directly impact approximately 5,680 acres of vegetation through the construction of well pads, roads, pipelines, and other ancillary facilities. Scrub/shrub vegetation types would be the most impacted under Alternative B, with the most acres impacted in the Colorado Plateau Mixed Low Sagebrush Shrubland (1,668 acres) and Inter-mountain Basins Mixed Salt Desert Scrub (1,285 acres) vegetation types (see Table 4-125). Inter-mountain Basins Greasewood Flat (3.1%), Montane Sagebrush Steppe (6.8%), Semi-Desert Grassland (4.2%), and Mixed Salt Desert Scrub (3.3%) would be most highly impacted in terms of the percentage of their acreage that would be disturbed in the project area. As with the Proposed Action, there would be fewer than 1 acre of disturbance to the small amount of Gamble Oak-Mixed Montane Shrubland in the project area. Impacts to riparian zones are discussed in Section 4.15, Water Resources.

Development under Alternative B would directly impact approximately 2.8 times the area of vegetation as would occur under the No Action Alternative. Approximately 19 times more Inter-mountain Basins Montane Sagebrush Steppe would be disturbed than under the No Action Alternative.

The area at risk for weed invasion under Alternative B would be equal to at least the 5,680 acres disturbed by roads, pipelines, well pads, and evaporative facilities. In addition, approximately 13,285 acres (or 6% of the project area) would have an elevated risk of cheatgrass invasion (see Table 4-126). Approximately 1,528 acres (or 0.7% of the project area) would be susceptible to invasion by halogeton, Russian thistle, and other species (see Table 4-126). Compared to the No Action Alternative, road and well-pad development under Alternative B would result in an increased risk of weed invasion over approximately an area 3.8 times larger.

Under Alternative B, dust impacts to vegetation would result from the construction and use of 274 miles of new roadways in the project area. Fire risk would increase over 5,680 acres of lands with surface disturbance. The 274 miles of new roads proposed would improve access to fight fires, but would also increase the risk of vegetation trampling by OHVs. Impacts related to roads would occur along 3.8 times as many miles of new roads under Alternative B as under the No Action Alternative, and the increased risk of spills along pipelines would occur along 1.2 times as many miles of new pipeline. The spill risk from evaporative facilities would be the same as under the Proposed Action.

4.13.1.3 Alternative C: Full Development

Direct and indirect impacts for this alternative would be similar to those under the Proposed Action, but would affect more acres. Construction under Alternative C would directly impact approximately 9,979 acres of vegetation through the construction of well pads, roads, pipelines, evaporative ponds, and other ancillary facilities.

Alternative C would also disturb the most acres in scrub/shrub vegetation types, with the greatest number of acres impacted in the Colorado Plateau Mixed Low Sagebrush Shrubland (2,703 acres) and Inter-mountain Basins Mixed Salt Desert Scrub (2,334 acres) communities (see Table 4-125). Inter-mountain Basins Greasewood Flat (5.5%), Montane Sagebrush Steppe (6.4%), Semi-Desert Grassland (4.5%), and Mixed Salt Desert Scrub (6.1%) would be most highly impacted in terms of the percentage of the acreage classified as a particular community that would be disturbed. Like the Proposed Action, there would be a small amount of disturbance to the limited Gamble Oak-Mixed Montane Shrubland in the project area. Approximately 1 acre (or 12%) of this community type in the project area would be disturbed (see Table 4-125). Impacts to riparian zones are discussed in Section 4.15, Water Resources.

Development under the Proposed Action would directly impact approximately 4.9 times the area of vegetation that would be affected under the No Action Alternative. Several community types would be impacted at a far higher rate relative to impacts under the No Action Alternative, however. Approximately 21 times more Rocky Mountain Montane Dry-Mesic Mixed Conifer Forest and Woodland, 18 times more Inter-mountain Basins Montane Sagebrush Steppe, and 9 times more Inter-mountain Basins Shale Badland would be disturbed.

The area at risk for weed invasion under Alternative C would be equal to at least the 9,979 acres disturbed by roads, pipelines, well pads, and evaporative facilities. In addition, approximately 25,503 acres (or 12% of the project area) would have an elevated risk of cheatgrass invasion, (see Table 4-126). Approximately 2,933 acres (or 1.4% of the project area) would be susceptible to invasion by halogeton, Russian thistle, and other species (see Table 4-126). Compared to the No Action Alternative, road and well-pad development under Alternative C would result in an increased risk of weed invasion over approximately 7.3 times as large an area.

Under Alternative C, dust impacts on vegetation would result from the construction and use of 526 miles of new roadways in the project area, approximately 62% more new roads than under the Proposed Action and 94% more roads than under current conditions. Fire risk would increase across 9,982 acres of lands with new surface disturbance (approximately 32% more than under the Proposed Action). The 526 miles of new roads proposed would improve access to fight fires more than other alternatives, but would also increase the risk of vegetation trampling by OHVs more than other alternatives. Impacts related to roads would occur along 7.3 times as many miles of new roads under Alternative C as under the No Action Alternative, and the increased risk of spills along pipelines would occur along 2.7 times as many miles of new pipeline. The spill risk from evaporative facilities would be the same as under the Proposed Action.

4.13.1.4 Alternative D: No Action

Direct and indirect impacts for this alternative would be similar to those under the Proposed Action, but would affect far fewer acres. Construction and operation activities under the No Action Alternative would directly impact approximately 2,055 acres of vegetation through the construction of well pads, roads, pipelines, evaporative ponds, and other ancillary facilities, or approximately 1% of the vegetation in the project area. Impacts under the No Action Alternative would also be concentrated in scrub/shrub vegetation types, with the most acres impacted in the Colorado Plateau Mixed Low Sagebrush Shrubland (506 acres) and Inter-mountain Basins Mixed Salt Desert Scrub (681 acres) communities (see Table 4-125). As under the other alternatives, Inter-mountain Basins Greasewood Flat (1.4%), Montane Sagebrush Steppe (0.4%), Semi-Desert Grassland (1.0%), and Mixed Salt Desert Scrub (1.8%) would be among those most highly impacted in terms of the percentage of acreage disturbed in the project area. As with the Proposed Action, there would be less than one acre of disturbance to the small amount of Gamble Oak-Mixed Montane Shrubland in the project area. Impacts to riparian zones are discussed in Section 4.15, Water Resources.

The area at risk for weed invasion under the No Action Alternative would be equal to at least the 2,055 acres disturbed by roads, pipelines, well pads, and evaporative facilities. In addition, approximately 3,491 acres (1.7% of the project area) would have an elevated risk of cheatgrass invasion (see Table 4-126). Approximately 401 acres (0.2% of the project area) would be susceptible to invasion by halogeton, Russian thistle, and other species (see Table 4-126).

Under the No Action Alternative, dust impacts to vegetation would result from the construction and operation of 72 miles of new roadways, approximately 78% fewer miles than under the Proposed Action. Fire risk would increase across 2,055 acres of lands with surface disturbance (approximately 73% fewer acres than under the Proposed Action). The 72 miles of new roads proposed would slightly improve access to fight fires, but would also slightly increase the risk of vegetation trampling by OHVs. The spill risk from evaporative facilities would be the same as under the Proposed Action.

4.13.1.5 Alternative E: Reduced Development with Directional Drilling

Direct and indirect impacts for this alternative would be similar to those under the Proposed Action, but would affect fewer acres. Construction under Alternative E would directly impact approximately 2,173 acres of vegetation through the construction of well pads, roads, pipelines, evaporative ponds, and other ancillary facilities. Scrub/shrub vegetation types would be the most impacted under Alternative E, with the greatest number of acres impacted in the Colorado Plateau Mixed Low Sagebrush Shrubland (623 acres) and Inter-mountain Basins Mixed Salt Desert Scrub (558 acres) vegetation types (see Table 4-125). Inter-mountain Basins Montane Sagebrush Steppe (2.6%), Southern Rocky Mountain Montane-Subalpine Grassland (2.0%), Inter-mountain Basins Semi-Desert Grassland (1.6%), and Inter-mountain Basins Mixed Salt Desert Scrub (1.5%) would be the most highly impacted in terms of acreage percentage disturbed in the project area. Impacts to riparian zones are discussed in Section 4.15, Water Resources.

Development under Alternative E would directly impact approximately 1.1 times the area of vegetation as would the No Action Alternative. Approximately 7.6 times as much Inter-mountain Basins Montane Sagebrush Steppe would be disturbed as under the No Action Alternative.

The area at risk for weed invasion under Alternative E would be at least the 2,173 acres disturbed by roads, pipelines, well pads, and evaporative facilities. In addition, approximately 5,139 acres (or 2.5% of the project area) would have an elevated risk of cheatgrass invasion (see Table 4-126). Approximately 591 acres (or 0.3% of the project area) would be susceptible to invasion by halogeton, Russian thistle, and other species (see Table 4-126). Compared to the No Action Alternative, road and well-pad development under Alternative E would result in an increased risk of weed invasion over approximately 1.5 times as large an area.

Under Alternative E, dust impacts to vegetation would result from the construction and use of 106 miles of new roadways in the project area. Fire risk would increase over 2,173 acres of land with surface disturbance. The 106 miles of new roads proposed would improve access to fight fires, but would also increase the risk of vegetation trampling by OHVs. Impacts related to roads would occur along 1.5 times as many miles of new roads under Alternative E as under the No Action Alternative, but the increased risk of spills along pipelines would occur along only 0.7 times as many miles of new pipeline. The spill risk from evaporative facilities would be the same as under the Proposed Action.

4.13.1.6 Alternative F: Agency Preferred Alternative

Direct and indirect impacts for Alternative F would be similar to those under the Proposed Action, but would affect fewer acres. Construction under this alternative would directly impact approximately 3,601 acres of vegetation through the construction of well pads, roads, pipelines, evaporative ponds, and other ancillary facilities. Scrub/shrub vegetation types would be the most impacted under Alternative F, with the greatest number of acres impacted in the Colorado Plateau Mixed Low Sagebrush Shrubland (1,166 acres) and Inter-mountain Basins Mixed Salt Desert Scrub (580 acres) vegetation types (see Table 4-125). Inter-mountain Basins Montane

Sagebrush Steppe (4.4%), Southern Rocky Mountain Montane-Subalpine Grassland (3.6%), Inter-mountain Basins Semi-Desert Grassland (3.6%), and Inter-mountain Semi-Desert Shrub Steppe (1.6%) would be the most highly impacted in terms of acreage percentage disturbed in the project area. Impacts to riparian zones are discussed in Section 4.15, Water Resources.

Development under Alternative F would directly impact approximately 1.8 times the area of vegetation as would the No Action Alternative. Approximately 12.6 times as much Inter-mountain Basins Montane Sagebrush Steppe would be disturbed as under the No Action Alternative.

The area at risk for weed invasion under Alternative F would be at least the 3,601 acres disturbed by roads, pipelines, well pads, and evaporative facilities. In addition, approximately 10,466 acres (or 5% of the project area) would have an elevated risk of cheatgrass invasion (see Table 4-126). Approximately 1,114 acres (or 0.5% of the project area) would be susceptible to invasion by halogeton, Russian thistle, and other species (see Table 4-126). Compared to the No Action Alternative, road and well-pad development under Alternative F would result in an increased risk of weed invasion over approximately 2.8 times as large an area.

Under Alternative F, dust impacts to vegetation would result from the construction and use of 198 miles of new roadways in the project area. Fire risk would increase over 3,601 acres of land with surface disturbance. The 198 miles of new roads proposed would improve access to fight fires, but would also increase the risk of vegetation trampling by OHVs. Impacts related to roads would occur along 2.8 times as many miles of new roads under Alternative F as under the No Action Alternative, and the increased risk of spills along pipelines would occur along 8.5 times as many miles of new pipeline. The spill risk from evaporative facilities would be the same as under the Proposed Action.

4.13.2 MITIGATION

In addition to the applicant-committed measures detailed in Section 2.2.9, several proposed measures could be used to reduce direct and indirect impacts to vegetation in the project area include of the following:

- During the construction, drilling, and completion season, Gasco would implement an intensive reclamation and weed-control program beginning the first growing season after each segment of project completion. Gasco would reseed in all portions of well pads and ROWs not used for the operational phase of the project, as well as any sites in the project area determined necessary by the appropriate AO.
- Reseeding would be accomplished by planting native species as much as practical, however, non native species may also be used where site specific conditions require them, or native species indigenous to the site are not commercially available, or as directed by the AO. Post-construction seeding applications would continue until determined successful by the AO.
- Mulching, soil amendments, and other state-of-the-art techniques will be used as determined necessary on a site-specific basis to assure the highest possible revegetation success.

- In areas that contain environmentally sensitive fragile soils and vegetation, the operator may be required to perform special measures such as mulching, erosion fencing, use of erosion fabric, etc., per the direction of the AO, to stabilize any disturbed areas and ensure the re-establishment of long-term perennial vegetation.
- Inter-seeding (i.e., seeding into existing vegetation), secondary seeding, or staggered seeding may be used as determined necessary on a site-specific basis to accomplish revegetation objectives.
- Vegetation removed from short-term surface-disturbance areas would be spread over the disturbed site to capture native seed and facilitate revegetation.
- Noxious weed infestations associated with well sites, well facilities, roads, ROWs, or any other area or facility constructed or improved for this project would be treated and controlled by a licensed pesticide applicator, with weed treatment protocols being specified through the AO. On BLM-administered land, an Approved Pesticide Use and Weed Control Plan would be implemented. Weed monitoring and reclamation measures would be continued on an annual basis (or as frequently as the AO determines) throughout the 30-year life of the project.
- All erosion-control products (such as mulches, straw bales, etc.) used would be certified weed-free.
- Riparian and wetland communities would be avoided; directional drilling would be used where necessary to avoid these communities.
- Construction equipment and vehicles coming from outside of the Uinta Basin would be power-washed prior to entering the project area. Any construction or operational vehicles traveling between the project area and areas outside of the Uinta Basin would be power-washed prior to reentrance.
- As directed by the AO, roads, trails, ROWs, well sites, etc. would be decommissioned and reclaimed.
- As directed by the AO, mats (wooden or other) would be used during drilling and other development to protect and preserve underlying vegetation.
- All seed, hay, and matting used for restoration would be certified weed-free.
- Areas disturbed by project-related activities (including roads, well pads, etc) with soils susceptible to wind erosion would be surfaced (covering of piles where appropriate, graveling or surfactants applied to roads, etc.) on a site-specific basis, as directed by the AO to reduce fugitive dust generated by traffic and related activities. Such treatments would also be applied as directed by the AO on local and resource roads that represent a dust problem.
- A pre-project inventory for noxious and listed weeds would be conducted in all areas subject to surface disturbance to identify treatment needs and to aid in the development of an AO-approved weed treatment plan.
- All applicable Fluid Minerals BMPs from Appendix R of the Vernal RMP (BLM 2008c) would be implemented.

4.13.3 UNAVOIDABLE ADVERSE IMPACTS

Removal of vegetation during land clearing and grading for the construction of roads, well pads, pipelines, and other ancillary facilities would be unavoidable under all alternatives, as would be an increased risk of accidental spills along roads and pipelines.

4.13.4 IRRETRIEVABLE AND IRREVERSIBLE COMMITMENTS OF RESOURCES

Because of the limited productivity and high potential for invasion (by non-native vegetation) of desert vegetation communities, vegetation functional value lost during construction would be irretrievable until restored through active rehabilitation measures. Because of the difficulty of eradicating invasive species such as cheatgrass, the replacement of native vegetation with invasive vegetation would also be an irretrievable impact until adequate restoration measures are successfully implemented.

4.13.5 RELATIONSHIP OF SHORT-TERM USES TO LONG-TERM PRODUCTIVITY

Impacts to vegetation occurring in the project area's arid to semi-arid climate could affect long-term productivity due to the limited annual growth of many of the plants found in this ecosystem. Recovery periods of up to 50 years may be required to return desert vegetation communities to their original vegetation cover and species composition following disturbance (Guo 2004). A period of 75 to 100 years may be required for reestablishment of mature pinyon-juniper woodlands. The recovery of cryptobiotic soil communities and associated vegetation is extremely slow (up to 250 years) following soil disturbance (BLM 2001).

4.14 VISUAL RESOURCES

For the purposes of this analysis, impacts to visual resources would be considered significant if the impacts of the proposed project do not conform to an area's designated visual resource management (VRM) class objectives. Short-term impacts are those that would affect visual resources for fewer than five years; long-term impacts would affect visual resources for more than five years (BLM 1986). The potential direct adverse impacts to visual resources would include the visual contrasts created by construction equipment, pipelines, well pads, temporary and permanent access roads, and other forms of infrastructure associated with gas exploration and development. In general, drilling rigs and equipment, construction and maintenance vehicles, development infrastructure, and surface disturbance, including roads, would impact an area's scenic quality and appearance of naturalness with human-made form, color, and linear contrasts. The visual impacts from producing wells (including permanent access roads, permanent well pads, pipelines, maintenance vehicles, and related infrastructure such as evaporative ponds, electrical generators, and dehydrators) would have similar visual contrasts with the natural landscape, and would persist throughout the production lifetime of the wells and during the 45-year project life.

The indirect visual effects of well exploration and development would include vehicle-related fugitive dust, which could adversely impact long-distance scenic quality (see Section 4.2, Air Quality). However, air-quality modeling (Trinity and Nichols 2005) indicates that these would be short-term impacts, and localized at a well-drilling operation because drilling would generate dust only during the time required to drill the well, construct the pad and associated roads and pipelines (well production would have negligible impacts on fugitive dust production), and to excavate the proposed evaporation ponds. Long-term fugitive dust generation by production-well maintenance vehicles and well-drilling activities could adversely impact long-distance scenic quality because these fugitive dust–producing activities would continue throughout the life of the project. However, air-quality modeling (Trinity and Nichols 2005) indicates that these impacts would not exceed PSD visibility standards (primarily affected by PM_{10} and $PM_{2.5}$) under any of the proposed alternatives. Also, ACMs for dust abatement along access roads would limit the potentially adverse effects of long-term, dust-related haze to long-distance scenic quality.

Development would also impact vegetation by creating conditions for the establishment of invasive species in surface-disturbance areas. This, in turn, could increase the risks of wildland fire, and potentially alter short- and long-term scenic quality because of the line and color visual contrasts created by fire. Short-term impacts on scenic quality from wildland fire would be in areas of relatively fast-growing herbaceous or forb vegetation, in which the visual contrasts would quickly diminish. Long-term impacts could occur within relatively slow-growing shrub or woodland areas (e.g., sagebrush, pinyon-juniper woodland), where regrowth of these species (with reduction in visual contrasts) could take decades. Short-term effects on visual resources would be related to well pad, access road, and infrastructure reclamation success. Short-term visual contrasts created by these structures and disturbances would diminish as vegetation became reestablished. (See Section 4.13, Vegetation, for a description of potential impacts to vegetation from the proposed alternatives.)

Potential direct impacts would include artificial light and associated sky glow from night lighting required for night-time drilling. This would be of particular concern in the high-recreation-use areas of the Nine Mile Canyon SRMA and the Green River corridor near the river rafting put-in at Sand Wash. Night lighting would degrade scenic quality by introducing intrusive, artificial lighting into an otherwise unlit natural landscape. Short-term visual impacts from both gas flaring and horizontal and vertical lighting at the well-pad locations would occur during the drilling period of 30 to 40 days. The locations of these temporary impacts would shift across the project area as each individual well is completed. Short-term impacts would also include drilling rig visibility at site-specific drilling locations during the day and night, as the rigs would be moved weekly or monthly depending on site-specific drilling depths. Long-term impacts (for the lifetime of the project) would include pipeline, infrastructure, and well-pad visibility; surface disturbances from well-pad construction; and access road construction.

For up to approximately 50 days per single well, well-pad construction and drilling, and the presence of drill rigs, vehicles, and other equipment would likely attract the attention of observers on public travel ways in the vicinity of drilling operations. Public travelways where the presence of drilling operations would be most noticeable would be along Wrinkle Road and Sand Wash Road. During the operations phase of the proposed project (approximately 30 years for each producing well), the presence of production equipment would still be noticeable at these locations, but site-specific BMPs and visual resource impacts mitigation would ensure that gas-development-related impacts would comply with VRM objectives.

4.14.1 METHODOLOGY

The methodology used to assess impacts to visual resources from the proposed alternatives is based on the BLM VRM Contrast Rating System. As described in Chapter 3, the BLM's VRM system is used to inventory and then designate VRM classes for the entire Vernal FO planning area. Each VRM class manages visual resources under visual resource objectives, and all proposed activities and projects in that area's VRM class must meet and/or comply with the applicable VRM objectives. Project-specific compliance with VRM objectives is determined by using a contrast rating system that assesses the degree of project-related changes to the existing natural landscape by assessing the potential changes to the existing form, line, color, and texture of landforms and/or water, vegetation, and structures.

Visual impacts resulting from the proposed project's well pads and related infrastructure can be semi-quantitatively determined by analyzing the potential impacts from proposed surface disturbances (the number of acres of disturbance) and the number of proposed wells in order to assess their visual impact on the project area's VRM classes. The impacts determination would use VRM Contrast Analysis Key Observation Points (KOPs) to assess visual impacts on the landscape. (The KOPs used in this analysis are described in Section 3.14. The visual analysis from these points is discussed below.)

Table 4-127 shows the acres of potential direct surface-disturbing impacts within each VRM class by alternative. The proposed development within designated VRM Class III and Class IV areas would be consistent with management objectives because the VRM objectives for these visual classes would permit moderate to major changes to the characteristic landscape that would accommodate the level of surface disturbances and visual contrasts created by proposed project activities. The same proposed development activities would take place in designated VRM Class II areas. However, Class II management objectives would allow only minor changes to the characteristic landscape, and any long-term, development-related surface disturbances and visually intrusive structures would be required to comply with those objectives. If proposed gas exploration and development were not consistent with the VRM Class II objectives, mitigation would be required to reduce the scenic-quality impacts to comply with Class II objectives (see 4.15.4 Mitigation, below). In addition, applicant-committed BMPs for the site-specific use of buried pipelines and centralized water and condensate tank facilities would reduce the visual impacts of pipelines and tanks where appropriate. As described in Chapter 2, before approving an APD, the BLM would conduct an on-site visual resource review to determine the appropriate site-specific mitigation measures to ensure that the site's proposed activities would comply with the VRM class objectives for the area.

Table 4-127. Acres of Disturbance within Visual Resource Management (VRM) Class Designations, by Alternative

VRM Class	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
I	0	0	2	0	0	0
II	139	59	368	32	27	3
III	1,316	750	1,656	215	286	857
IV	4,826	3,665	6,420	1,288	1,424	2,117
Total	6,281	4,474	8,446	1,535	1,737	2,977

4.14.2 Direct and Indirect Effects

4.14.2.1 Alternative A: Proposed Action

As described in Chapter 3 (Visual Resources), seven KOPs were selected for use in the contrast-rating process to assess the impacts of the proposed project on visual resources and scenic quality. The KOP areas are the Green River Shoreline, Fourmile Bottom, west of Blind Canyon (in Nine Mile Canyon), Wild Horse Bench (on the east side of the Green River corridor), the Sand Wash Road, the Wrinkle Road and Franks Canyon OHV trail intersection, and Wrinkle Road at the head of Devils Canyon. Overall, when compared to the No Action Alternative, the Proposed Action would have more adverse impacts to visual resources because there would be more acres of surface disturbance from well-pad development and access road construction and more sky glow from night lighting. In addition, a total of 1,491 wells would be proposed for drilling under the Proposed Action (more than 4 times the number in the No Action Alternative). An analysis of how this development would affect each of the KOPs is discussed below.

4.14.2.1.1 KOP 1: Green River Shoreline

Under the Proposed Action, a small number of proposed wells in the vicinity of the shoreline would likely be visible, and GIS-based viewshed analysis and contrast analysis indicate that at least 2 wells would be seen within Utah state-administered lands along the river corridor from the river shoreline at this viewpoint, with the likelihood that four wells would be visible along the river immediately upstream and downstream of this KOP. Drilling rigs would likely be visible in the short-term along the designated VRM Class II area beyond state lands, and gas-production infrastructure would potentially be visible in the long-term. Site-specific mitigation (e.g., topographic screening, camouflage coloring) would likely reduce the impacts to comply with VRM Class II objectives on BLM-administered lands in the river corridor. In addition, applicant-committed BMPs for the site-specific use of buried pipelines and centralized water and condensate tank facilities would reduce the visual impacts of pipelines and tanks where appropriate. Indirect night-lighting impacts would reduce scenic quality caused by skyglow, but lighting mitigation would minimize these impacts (see Mitigation, below).

4.14.2.1.2 KOP 2: FOURMILE BOTTOM

From KOP 2, contrast analysis and GIS viewshed analysis show that no proposed well pads would likely be visible—the steep river bluffs would effectively block all long-term well-pad disturbances on designated VRM Class II and Class IV areas from this point of view, and there are no proposed wells located close to this river segment. The angle of view from the access road into Fourmile Bottom would obstruct drilling-related disturbances, and the middle-ground cliffs along the river corridor would reduce visibility behind the canyon, making the observable impacts to the landscape unlikely. Exploration drilling rigs would potentially be visible because of their height, and have adverse impacts on scenic quality, but these would be short-term impacts.

The view west and southwest from the KOP is of a mostly undeveloped landscape inventoried and found to have natural character (BLM 2007h). Surface disturbance associated with road and well pad construction would alter the natural appearance of these lands and introduce human-made structures to the existing landscape. The effect would be as described in the beginning of this section. However, these changes to the middle_ground and background landscapes would not be visible from this KOP and no wells are proposed in the foreground along the river.

4.14.2.1.3 KOP 3: WEST OF BLIND CANYON

Contrast analysis and GIS-based viewshed analysis indicate that no wells in designated VRM Class III areas in the Nine Mile Canyon area would be visible from this KOP. The analyses show that the proposed well locations would be placed above the rim of Nine Mile Canyon (and outside of designated VRM Class III areas), and would therefore either be out of sight or be site-specifically relocated through VRM mitigation to topographically hide them.

The view north and northeast from the KOP is of a largely undeveloped landscape inventoried and found to have natural character (BLM 2007h). Natural gas production would result in the construction of roads and well pads and in the placement of human-made structures on the land, with effects as described in the beginning of this section. However, the proposed wells would be located above the rim of the canyon and would not be visible from this KOP.

4.14.2.1.4 KOP 4: WILD HORSE BENCH

When the project area is viewed from this KOP, well pads, surface disturbances, vehicles, equipment, and infrastructure related to the Proposed Action would be visible. However, the relatively long-distance and background views of proposed facilities (e.g., evaporation ponds, dehydrators, well pads, drilling rigs, access roads) from this cross-river KOP would create a scattered, indistinct pattern that would partially retain the line, form, color, and texture of the landscape in the KOP viewshed. The impacts on scenic quality from this point of view would include views of color and line contrasts created by access road surface disturbances, pipelines, and production well pads with their infrastructure. However, the distance to the nearest well pad (based on viewshed analysis) proposed on designated VRM Class IV areas would be more than 2 miles; the nearest potentially impacted areas in designated VRM Class III areas would be approximately 3 miles away. It should be noted that no wells are proposed for drilling in the middle_ground area along the Green River corridor where VRM Class II has been designated.

The view southwest (>2 miles) from the KOP is of a mostly undeveloped landscape inventoried and found to have natural character (BLM 2007h). Natural gas production would result in the construction of roads and well pads and in the placement of human-made structures on the land, with effects as described at the beginning of this section. Because this development would be viewed at greater distances in the background, its effect on the undeveloped character of the landscape would be reduced but would include a reduction in the area's appearance of naturalness.

Compared to the No Action Alternative, this alternative would have more long-term adverse impacts on scenic quality and visual resources because more wells would be visible, and more surface-disturbing impacts from gas exploration and development would be present. However, the visually intrusive well structures and surface disturbances would be in compliance with visual resource management under VRM class objectives.

4.14.2.1.5 KOP 5: Sand Wash Road

From the Sand Wash Road KOP, viewshed analyses indicate that up to 3 well pads, a well-pad spur road, and a roadside gas pipeline would potentially be visible within the surrounding VRM Class III area and along the roadway, with adverse impacts on scenic quality. Drilling rigs would be visible in the short-term along the road and potentially visible along the ridgeline to the north (because of their height), which would create project-related form contrasts with the surrounding landscape. Proposed roadside pipeline construction would adversely impact scenic quality because of its proximity to travelers on the road and the strong linear contrasts created by the pipeline. Long-term impacts would include the adverse visual intrusion of well pads and the pipeline along the roadway, and the proximity of this infrastructure to casual viewers as they travel along the roadway. However, as discussed for KOP 1 above, applying site-specific mitigation (see Section 4.14.3) to reduce project-related contrasts would reduce the long-term impacts to comply with VRM Class III objectives. If conditions allow the roadside pipeline to be buried, then this potential linear impact would be reduced to a negligible level.

4.14.2.1.6 KOP 6: Wrinkle Road

From the perspective of this KOP, well pads would be constructed along the Bad Land Cliffs ridgeline to the north and along the flat to rolling landscapes to the south of Wrinkle Road. A proposed spur road would be constructed just west of the KOP and a proposed roadway pipeline would be laid to the north and west of the KOP. Short–term, adverse visual intrusion-related impacts would be caused by the height of the drilling rigs at all of the proposed well sites that would create form contrasts with the surrounding landscapes, and the road and pipeline that would create linear contrasts. As mentioned in Section 4.14, construction vehicles and personnel associated with this short-term construction would also create form and color contrasts, with adverse impacts on scenic quality.

In the long term, the spur road and surface pipeline would continue to create linear contrasts, and the proposed infrastructure at developed wells would potentially create form contrasts and would attract the attention of the casual viewer because of their proximity to the roadway. Applicant-committed mitigation measures would reduce these contrasts through camouflage painting, and/or topographically hiding or partially obscuring the well pads from casual viewers traveling along Wrinkle Road. Linear contrasts would be reduced through appropriately colored painting of the pipeline (if conditions do not allow it to be buried) and feathering of the spur road edges.

Also, constructing the proposed spur roads that access the cliff-top sites to the north along natural contours and minimizing cut-and-fill would potentially reduce their visibility from Wrinkle Road. Applying mitigation to the long-term well-pad infrastructure, access ways, and surface disturbances would reduce scenic quality impacts to be in compliance with VRM Class III objectives.

Under this alternative, well-pad development and infrastructure would be constructed to the south of the road within designated VRM Class II areas. Viewshed analyses show that at least one well pad would be visible to viewers from this Wrinkle Road KOP (the well pad is proposed for construction in Franks Canyon, south of the KOP), and an adjoining spur road and pipeline would also be built within the canyon. Long-term impacts would be caused by visible surface disturbances and visibility of the well and well infrastructure. The development under this alternative, unmitigated, would likely not comply with VRM Class II objectives, which requires a low level of change and although impacts may be visible, should not attract the attention of the casual viewer. If mitigation measures (site coloring, road and site edge feathering, hiding the structures, road that follows natural contours, etc) were effective in reducing visibility, then it would meet VRM Class II, but if site-specific measures were not able to reduce visiblity, then impacts would not meet objectives. Short-term impacts would likely exceed the VRM Class II objectives because night-time lighting from well drilling and the presence and movement of construction vehicles and equipment in designated VRM Class II would attract casual viewer attention.

It should be noted that additional well pads and related infrastructure, spur roads, and pipelines would be proposed for construction in the VRM Class II areas south of Wrinkle Road, beyond the visibility of this KOP, but still visible from other points along the roadway. The short-term impacts would be the same as discussed above. If mitigation could be successfully applied at these sites to reduce visual contrasts in the long-term, then site-related impacts would likely meet VRM Class II objectives; if mitigation was not or could not be successfully applied, then the impacts within these areas would not meet the Class II objectives.

4.14.2.1.7 KOP 7: Wrinkle Road and Devils Canyon

The short-term impacts of well pad and infrastructure construction and surface disturbances from spur road construction would be the same as discussed above for KOP 6 because the level of development would be the same as for KOP 6. The types of long-term impacts would be similar to the impacts discussed above for KOP 6 VRM Class III areas; however, the degree of impacts would be less than those at KOP 6 because no roadside pipeline would be proposed for construction along this section of roadway and no VRM Class II area would be potentially affected (there are no Class II areas near this KOP). It should be noted (see Section 3.14.2.7) that natural gas wells, access roads, and a roadside surface-laid pipeline are already present along this portion of Wrinkle Road. Visual contrasts created under this alternative would be consistent with existing surface disturbances and visual contrasts, and applicant-committed mitigation measures and BMPs would reduce the additional impacts to be in compliance with VRM Class III objectives. Topographic screening and camouflage painting of structures would reduce long-term contrasts so that development would not dominate the view, though these infrastructures and surface disturbances would likely attract the attention of the casual viewer traveling along Wrinkle Road.

4.14.2.2 Alternative B: Reduced Development

There would be fewer impacts to visual resources and scenic quality under Alternative B than under the Proposed Action because, while the same types of drilling and production activities would be conducted, this alternative would propose a very small area designated as VRM Class II for gas exploration and development (see Table 4-127). Under Alternative B, there would be a reduction in the number of proposed wells, with a reduced degree of impacts to visual resources or of observable impacts to scenic quality.

Compared to the No Action Alternative, this alternative would have more adverse impacts to visual resources because there would be more acres of potential surface disturbances from gas exploration and development and more sky glow from night lighting. A total of 1,114 wells would be proposed for drilling under this alternative; 3 times more than under the No Action Alternative.

4.14.2.2.1 KOP 1: Green River Shoreline

From this viewpoint, viewshed and contrast analysis indicate that one proposed well pad would be visible within the Utah state-administered land within the Green River corridor to the south, and 2 wells would likely be visible on state lands in the river corridor if the viewpoint was shifted 0.5 mile or less upriver. The impacts to visual resources would be the same as discussed under the Proposed Action because the number of potentially visible wells and their locations are similar to the Proposed Action.

4.14.2.2.2 KOP 2: Fourmile Bottom

As discussed under the Proposed Action, viewshed and contrast analysis indicate that no proposed well pads would be visible from or in the vicinity of this KOP, so the impacts to visual resources would be the same as discussed under the Proposed Action.

4.14.2.2.3 KOP 3: West of Blind Canyon

The impacts to visual resources in Nine Mile Canyon from this viewpoint would be the same as discussed under the Proposed Action.

4.14.2.2.4 KOP 4: Wild Horse Bench

When viewed from the vantage point of this KOP, the potential impacts and visual contrasts would be the same as discussed under the Proposed Action, based on contrast analysis and viewshed analysis. This is because similar indistinct background views of minerals exploration and development would be visible with the same level of impacts. The closest proposed well pad in designated VRM Class IV areas would be more than 2 miles away; visible well pads in VRM Class III areas would be over 4 miles away; and proposed well pads in VRM Class II areas near Nine Mile Canyon would be no closer than 10 miles away. As mentioned above, no well sites are proposed for drilling in the VRM Class II middle ground areas of the Green River corridor.

4.14.2.2.5 KOP 5: Sand Wash Road

Under Alternative B, the impacts of drilling and well-pad construction, when viewed from this KOP, would predominantly consist of impacts caused by construction and operation of the proposed roadside pipeline. If surface-laid, the impacts would adversely affect scenic quality by creating obvious linear contrasts, but if conditions allowed it to be buried, then the impacts would be reduced to a negligible level. Viewshed analyses indicate that well pads would be potentially visible from the roadway. However, a combination of viewing distances to these sites and atmospheric haze would likely reduce the impacts to a minor degree (viewshed analysis shows that viewing distances would be at least 1 mile and located in VRM Class IV areas). Impacts to scenic quality would meet VRM Class III objectives.

4.14.2.2.6 KOP 6: Wrinkle Road and Franks Canyon

The types of short-term and long-term impacts would be similar to those discussed under the Proposed Action for this KOP because the same well-pad infrastructure, well-pad access roads, and pipeline would be constructed in similar northern cliff top locations as described under the Proposed Action. However, under this alternative, no well pads would be constructed to the south of Wrinkle Road, which would reduce the potential infrastructure-related visual intrusions and surface disturbances to a greater degree than the Proposed Action. There would be fewer surface disturbances and project-related visual contrasts in VRM III areas, and areas adjacent to and within VRM Class II to the south of the road would not be disturbed. Applying visual impacts mitigation as discussed under the Proposed Action would reduce impacts to be in compliance with both VRM Class III and VRM Class II objectives.

4.14.2.2.7 KOP 7: Wrinkle Road and Devils Canyon

The impacts to scenic quality would be the same as discussed for KOP 6 above because the level of development would be the same, with the exception that no roadside pipeline would be constructed because a pipeline already runs along this portion of Wrinkle Road. With applicant-committed mitigation and BMPs applied, the impacts would meet long-term VRM Class III objectives because visual contrasts would be reduced.

4.14.2.3 Alternative C: Full Development

The impacts to visual resources under Alternative C would be similar to those discussed under the Proposed Action, but to a greater degree due to the increased likelihood of impacts to visual resources from the larger number of proposed wells (a total of 1,887 wells).

Compared to the No Action Alternative, this alternative would have more adverse impacts on visual resources because more wells would be proposed for drilling, with more acres of surface disturbance and more sky glow from night lighting that would impact visual resources and scenic quality.

4.14.2.3.1 KOP 1: Green River Shoreline

From this KOP, the viewshed and contrast analyses show that a single well would be visible in the Utah state-administered lands along the Green River corridor, with the likelihood that 2 additional well pads in the same area would be visible from the river if the viewpoint was shifted less than 0.5 mile upriver. The impacts would be the same as discussed under the Proposed Action because the number of visible well pads would be similar.

4.14.2.3.2 KOP 2: Fourmile Bottom

As discussed under the Proposed Action, viewshed and contrast analysis indicates that no proposed well pads would be visible from or in the vicinity of this KOP, so the impacts to visual resources would be the same as discussed under the Proposed Action.

4.14.2.3.3 KOP 3: West of Blind Canyon

The impacts to visual resources from proposed well placement along the Nine Mile Canyon access road would be the same as discussed under the Proposed Action.

4.14.2.3.4 KOP 4: Wild Horse Bench

The impacts to visual resources would be the same as discussed under the Proposed Action because, as shown in the contrast and viewshed analyses, indistinct background views of proposed gas project activities and surface disturbances would be visible within designated VRM Class II, III, and IV areas.

4.14.2.3.5 KOP 5: Sand Wash Road

The types of impacts to scenic quality would be similar to those discussed under the Proposed Action for this KOP, but project-related impacts would be greater. This is because under Alternative C, viewshed analyses indicate that up to five well pads would be visible along ridgelines to the north and south of the roadway (two more well pads than under Alternative A) creating visually intrusive form contrasts. In addition, 2 spur roads (one more than Alternative A) would be constructed to the east and west of the KOP creating line and color contrasts, and a roadside pipeline would run the length of Sand Wash Road, also creating line and color contrasts with the surrounding landscape. The short-term and long-term impacts to scenic quality from well-pad construction, drilling, and well-pad operations would be adverse, but mitigation would reduce these impacts to meet VRM Class III objectives. Objectives would be met because the long-term impacts of well-pad construction and development would have proponent-committed BMPs and mitigation applied as discussed under the Proposed Action: wells and related infrastructure would be sited for reduced visibility and appropriately painted to reduce contrasts; the pipeline would be buried, if conditions allowed. Project-related impacts would still be visible to Sand Wash Road travelers, but the visual intrusions and surface disturbances would not dominate the view.

4.14.2.3.6 KOP 6: Wrinkle Road and Franks Canyon

The proposed full development of well pads, access ways, and pipelines under this alternative would include locating wells along Wrinkle Road, on the flat areas to the south of the roadway and on the northern slopes and cliff tops. Access spur roads would extend north and south from Wrinkle Road at regularly spaced intervals, and a main pipeline would follow the roadway with collector lines running north and south to the proposed well pads. The types of impacts to scenic quality would be same as discussed under the Proposed Action because the same infrastructure would be built and surface disturbances would occur. However, the degree of impacts to scenic quality due to increased well pad and infrastructure development would be greater under this alternative.

With mitigation applied as discussed under the Proposed Action and in Section 4.14.3, Mitigation, the impacts caused by maximum development under this alternative would still likely exceed the designated VRM Class III objectives for this area. Class III objectives (see Section 3.14.1) stipulate that impacts should be moderate and, although allowed to attract the attention of the casual viewer, should not dominate the view of the casual observer. Viewshed analyses show that up to six well pads would be visible from this KOP, and that well spacing and the density of infrastructure would not change within the VRM Class III areas along the road to east or west, so the level of impacts would not diminish. Also, the locations of well-pad development would impact designated VRM Class II areas to the south that are visible from this locale, with proposed well pads, pipelines, and spur roads within Franks Canyon to the south of the KOP (an area designated as VRM Class II). The impacts would be short-term, caused by visually intrusive drilling and heavy equipment and construction vehicles, night lighting, and drilling rigs.

The long-term impacts would be caused by visible surface disturbances and well infrastructure. The development in Franks Canyon under this alternative, even with mitigation applied, would be difficult to screen topographically and therefore would not likely comply with VRM Class II objectives, which requires a low level of change and although impacts may be visible, should not attract the attention of the casual viewer.

4.14.2.3.7 KOP 7: Wrinkle Road and Devils Canyon

As discussed above for VRM Class III areas near KOP 6, a similar level of well-pad development and related infrastructure construction along the roadway corridor and to the north and south of the roadway at KOP 7 would have long-term impacts on scenic quality that would likely exceed VRM Class III objectives. Project-related development would not comply with those objectives for the same reasons as discussed above.

4.14.2.4 Alternative D: No Action

Under the No Action Alternative, 368 wells would be proposed for drilling in the project area.

4.14.2.4.1 KOP 1: Green River Shoreline

Under this alternative, viewshed and contrast analyses indicate that a single well within Utah state-administered lands along the river corridor would be visible from the river at this viewpoint, with the likelihood that 2 to 3 wells would be visible on state lands within the river corridor if the viewpoint was shifted upriver approximately 0.5 mile. The impacts to visual resources would be the same as discussed under the Proposed Action because the potential visibility of well pads would be similar.

4.14.2.4.2 KOP 2: Fourmile Bottom

As discussed under the Proposed Action, viewshed and contrast analyses indicate that no proposed well pads would be visible from or in the vicinity of this KOP, so the impacts to visual resources would be the same as those discussed under the Proposed Action.

4.14.2.4.3 KOP 3: West of Blind Canyon

The impacts to visual resources in the VRM Class III areas of Nine Mile Canyon would be the same as those discussed under the Proposed Action.

4.14.2.4.4 KOP 4: Wild Horse Bench

The impacts to visual resources would be the same as discussed under the Proposed Action, but to a lesser degree because, as shown in the contrast and viewshed analyses from this KOP, indistinct background views of proposed gas project activities and surface disturbances would be visible. The degree of visual impacts would be reduced because fewer wells would be proposed and drilled under this alternative. The visual resources analyses indicate that the nearest proposed well pad in designated VRM Class IV area would be more than a mile away; the nearest proposed well pad in VRM Class III areas along the river corridor would be over 4 miles away; and no proposed well pads would be visible in the designated VRM Class III areas near Nine Mile Canyon. The impacts in the designated VRM Class II areas of the Green River corridor would be the same as discussed under the Proposed Action.

4.14.2.4.5 KOP 5: Sand Wash Road

There would be no impacts to scenic quality as viewed from this KOP because there would be no well-pad construction, pipeline construction, or spur roads built near the roadway or within the VRM Class III area surrounding the roadway.

4.14.2.4.6 KOP 6: Wrinkle Road and Franks Canyon

Under the No Action Alternative, viewshed analyses show that one proposed well pad and spur road would be constructed close to the road, to the east of the KOP, and visible to casual observers, and pipelines would be constructed along Wrinkle Road and along the spur road. The impacts to scenic quality would be similar to those discussed for Sand Wash Road (KOP 5) under the Proposed Action (Alternative A) because the level of development and visibility of proposed infrastructure would be similar. Thus, impacts within VRM Class III landscapes would be in compliance with visual objectives and there would be no impacts to VRM Class II areas to the south of Wrinkle Road.

4.14.2.4.7 KOP 7: Wrinkle Road and Devils Canyon

Visual viewshed analyses show that under this alternative there would be minimal long-term impacts to scenic quality caused by well-pad construction. One well pad, spur road and connector pipeline would be visible to the south from this viewpoint. The degree of contrasts created by proposed development would likely meet VRM Class III objectives because the small number of well pads and surface disturbances would not dominate the view of casual observers.

4.14.2.5 Alternative E: Reduced Development with Directional Drilling

Under this alternative, the impacts to visual resources when viewed from the Green River Shoreline, Fourmile Bottom, and Nine Mile Canyon (the Blind Canyon KOP) would be similar to the No Action Alternative because the potential disturbance in areas designated VRM Class II, III, and IV would be similar—even though the number of proposed wells would be the same as proposed under Alternative B (Reduced Development). This is because the well pads under Alternative E would be clustered, which would concentrate surface disturbances and sky glow from night lighting into fewer areas and on fewer acres.

The visual contrasts and impacts on visual resources would be the same as the No Action Alternative because Alternative E would impact a similar number of acres of designated VRM Classes II, III, and IV.

4.14.2.5.1 KOP 1: Green River Shoreline

From the Green River shoreline at this viewpoint, none of the proposed well pads in BLM-administered or Utah state-administered lands along the river corridor would be visible. Based on GIS viewshed analysis, well-pad drilling rigs would likely be visible in the short term from a proposed well cluster in Sheep Wash to the north if the viewpoint was shifted upriver approximately 0.5 mile. The impacts would be the same as discussed under the Proposed Action, but to a lesser degree, because there would be short-term impacts to scenic quality from well-pad visibility, and if long-term scenic quality impacts were potentially produced by the well-pad cluster, then site-specific mitigation could be applied as needed to reduce its visibility and meet VRM Class II management objectives in the Green River corridor.

4.14.2.5.2 KOP 2: Fourmile Bottom

As discussed under the Proposed Action, viewshed and contrast analyses indicate that no proposed well pads would be visible from this KOP, so the impacts to visual resources would be the same as described under that alternative.

4.14.2.5.3 KOP 3: West of Blind Canyon

Contrast analysis and viewshed analysis indicate that no well-pad clusters would be visible in the VRM Class III areas in Nine Mile Canyon, with impacts as discussed under the Proposed Action.

4.14.2.5.4 KOP 4: Wild Horse Bench

From this viewpoint, the impacts to visual resources would be the same as discussed under the No Action Alternative because the views of proposed well-pad clusters and infrastructure would be the same: indistinct background views of project-related surface disturbances and visual intrusions that would likely meet VRM objectives in designated VRM Class III and Class IV areas, with no visible impacts on visual resources in the designated VRM Class III areas in and adjacent to Nine Mile Canyon. Under this alternative, no wells are proposed in the designated VRM Class II areas along the Green River corridor.

4.14.2.5.5 KOP 5: Sand Wash Road

The impacts from this viewpoint would be the same as discussed under Alternative B because, based on the results of viewshed analyses, the impacts to scenic quality would be caused by the roadside pipeline's linear contrasts if the pipeline was not buried. Viewshed analyses show that proposed well pads in this area would lie to the south and west of the KOP, beyond the VRM Class III areas and beyond the range of visibility for the casual viewers traveling along this roadway.

4.14.2.5.6 KOP 6: Wrinkle Road and Franks Canyon

The short-term and long-term impacts to scenic quality under this alternative would be similar to those discussed for KOP 5 Sand Wash Road under the Proposed Action (Alternative A) because the visibility of proposed well pads and infrastructure, and the landscape form, line, color, and texture contrasts created by those structures and surface disturbances would be similar. Project-related structures and surface disturbances would likely attract the attention of the casual observer, but mitigation would reduce these impacts so that they do not dominate the view.

4.14.2.5.7 KOP 7: Wrinkle Road and Devils Canyon

One roadside well pad would be constructed in the vicinity of the KOP under this alternative. The impacts would be similar to the No Action Alternative (Alternative D) for KOP 7 because, as discussed under that alternative, a very low level of well pad development would create minimal visual contrasts with the existing landscape, and would meet VRM Class III objectives.

4.14.2.6 Alternative F: Agency Preferred Alternative

As a combination of clustered directional drilling and selective vertical drilling, this alternative would develop 1,298 wells on 575 well pads, with related infrastructure, spur roads, and connector pipelines. The impacts would be greater than the No Action Alternative because there would be more surface disturbances within designated VRM Class III and IV areas. The surface disturbance impacts would be less than the Proposed Action (Alternative A) and Alternative C because there would be less total acreage impacts, and the impacts within designated VRM Class III and Class IV areas would also be less than those action alternatives.

4.14.2.6.1 KOP 1: Green River Shoreline

Under this alternative, 2 wells would be drilled within state-administered lands that extend to the Green River shorelines and a single well drilled at the designated VRM Class II and Class III boundary to the west of the shoreline. Both wells would be more than ½ mile from the Green River, and viewshed analyses show that none of the wells would be visible from this KOP, so there would be no long-term impact to scenic quality from the development of these proposed well sites. There could be be short-term, adverse impacts to scenic quality caused by night lighting if casual viewers were camping along the river shoreline during drilling and development of these well pads.

4.14.2.6.2 KOP 2: Fourmile Bottom

The short-term and long-term impacts to scenic quality would be the same as discussed for KOP 1 above for the same reasons. Viewshed analysis shows that no proposed wells would be visible from this KOP.

4.14.2.6.3 KOP 3: West of Blind Canyon

The short-term and long-term impacts to scenic quality would be the same as discussed for KOP 1 for the same reasons. Viewshed analysis shows that no proposed wells would be visible from this KOP, but short-term night lighting of exploration wells would potentially affect dark sky viewing.

4.14.2.6.4 KOP 4: Wild Horse Bench

The impacts to scenic quality from this KOP would be similar that those described for KOP 4 under the Proposed Action (Alternative A) for the same reasons. No well pads and infrastructure would be constructed within designated VRM Class II areas along the Green River shoreline (the area most visible from this KOP), though 2 wells would be constructed within state-administered lands that extend to the shoreline. Indistinct views caused by the long viewing distances would reduce visual contrasts to be in compliance with designated VRM Class II, III, and IV areas that lie within the proposed project area.

4.14.2.6.5 KOP 5: Sand Wash Road

The impacts would be similar to those described for this KOP under the Proposed Action (Alternative A), but to lesser degree. Well pads would potentially be visible to the north and south along the top of the cliffs that overlook the roadway, and a spur road and pipeline would be visible to the west of the KOP. Impacts would be reduced because the roadside pipeline would not extend along the full length of the roadway, but would terminate northwest of the KOP at a well pad. As discussed under the Proposed Action, BMPs and other applied visual mitigation would reduce the impacts to scenic quality to comply with VRM Class III objectives.

4.14.2.6.6 KOP 6: Wrinkle Road and Franks Canyon

Under the Agency Preferred Alternative, the types of impacts to scenic quality within VRM Class III areas would be similar to those discussed for this KOP under the Proposed Action (Alternative A) because visible well pads would be located to the north and south of the roadway and adjacent to the roadway, and roadside pipelines and well-pad spur roads would be visible to the casual viewer traveling east or west along Wrinkle Road. However, the degree of visual impacts and visual contrasts would be less because this alternative would propose to construct well pads and related infrastructure at a lower density than the Proposed Action. The impacts to landscapes within VRM Class II areas south of the KOP would consist of several short segments of pipeline and spur roads that cross the upper portion of Franks Canyon. As discussed under the Proposed Action, the short term impacts from construction of these lines and well pad access road would not likely be in compliance with VRM Class II objectives for the same reasons: night lights and construction vehicle visibility to casual viewers traveling along Wrinkle Road. The long term impacts would likely be in compliance with VRM Class II objectives if mitigation measures were successfully applied to reduce the visibility of the pipelines and spur roads. If mitigation measures were unsuccessful and these features could not be sufficiently obscured from casual view, then they would likely attract attention from travelers on Wrinkle Road and within Franks Canyon, and would not meet visual objectives and not be in compliance with VRM Class II.

4.14.2.6.7 KOP 7: Wrinkle Road and Devils Canyon

The impacts would be the same as discussed above for KOP 6 because the level of well-pad development, spur road construction, and other infrastructure would be the same, except that a roadside pipeline would not be constructed as a surface pipeline has already been laid along this segment of Wrinkle Road. Therefore, the long term impacts would likely be in compliance with VRM Class II objectives if mitigation measures were successfully applied to reduce the visibility of the pipelines and spur roads. If mitigation measures were unsuccessful and these features could not be sufficiently obscured from casual view, then they would likely attract attention from travelers on Wrinkle Road and within Franks Canyon, and would not meet visual objectives and not be in compliance with VRM Class II.

4.14.3 Mitigation

Proposed mitigation measures are the same under all alternatives. On-site visual reviews during the APD process would determine if sufficient mitigation could be applied to meet VRM class objectives.

The BLM VRM mitigation measures could include the following actions:

- Camouflage coloring, facility design, low-profile structures, proper placement, edge feathering along access roads and vegetation/road boundaries, and/or topographic screening would be used to reduce or eliminate the observable effects of gas well pads, roads, and infrastructure. Topographic screening and proper placement could include hiding the facilities behind ridge lines, in natural depressions, behind vegetation, or behind rock outcrops.
- Interim site and access road reclamation would occur to reduce the visual size of surface disturbance.
- Surface disturbances would be minimized by sharing ROWs, off-site directional drilling, and off-site placement of storage tanks.
- When feasible, pipelines would be buried in the road.
- The proposed well-pad size would be reduced to the minimum necessary.
- Night-lighting and light pollution skyglow impacts would be reduced as feasible by using only the minimal lighting required for safety and security, installing lights at the minimal heights required, and installing hoods on lights to reduce light diffusion.
- To preserve the integrity of viewsheds, during the APD processing, and as feasible, the Operator and AO would: jointly determine the use of topographic features to serve as visual screens; place facilities away from highly visible points such as ridgelines; use low-profile tanks to reduce visibility where taller tanks would be more visible; and avoid excessive side-casting of earth materials from ridgelines and steep slopes.
- As feasible and in order to reduce visual impacts, the Operator would use centralized tank locations for water and condensate tanks. The feasibility of centralizing tank facilities would be determined on a site-specific basis.

4.14.4 Unavoidable Adverse Impacts

The presence of drilling rigs, and the construction of well pads, pipelines, gas production infrastructure, and access roads would be an unavoidable consequence of natural gas development and extraction. These activities would cause adverse surface-disturbing and visual intrusion-related impacts to visual resources by introducing line, color, form, and textural contrasts onto the existing natural landscape in the long term and by and reducing the appearance of naturalness present in some parts of the project area. Night-lighting would cause sky glow impacts in the short-term.

It should be noted that proposed development under Alternatives B, C, and D would impact designated VRM Class II areas near the Green River corridor, and Alternatives A and C would impact VRM Class II and Class III areas along Wrinkle Road. Site-specific visual analysis during the APD process would determine if sufficient mitigation could be applied to meet VRM Class II objectives. Where valid and existing leasing rights predate the current RMP, unavoidable adverse impacts to scenic quality could result from project-related development. However, applicant-committed BMPs for the site-specific use of buried pipelines and centralized water and condensate tank facilities would reduce the visual impacts of pipelines and tanks where appropriate.

4.14.5 Irretrievable and Irreversible Commitments of Resources

There would be no irreversible impacts expected for aesthetic (visual) resources as a result of the Proposed Action and alternatives. Areas of surface disturbances can be reclaimed; well pads can be capped and buried; pipelines can be removed; and access roads can be closed and reclaimed. There would be a long-term irretrievable loss of scenic quality during the 45-year project lifetime from the presence of the above-mentioned gas wells and infrastructure until these structures were removed and/or the disturbed areas were reclaimed (after an estimated 30-year lifetime for each producing well).

4.14.6 Relationship of Short-term Uses to Long-term Productivity

The short-term development and extraction of fluid minerals resources would have long-term adverse impacts on visual resources and scenic quality. Surface disturbances from access road and well-pad construction, and the presence of drilling rigs would introduce line, form, color, and texture contrasts into the landscape. These contrasts would reduce long-term scenic quality by disturbing the existing character of the natural landscape during the lifetime of the proposed project, and after the project has ended until reclamation and revegetation have successfully obscured the project impacts. However, the long-term adverse impacts to visual resources would still comply with BLM visual resource management objectives.

4.15 Water Resources

This section addresses potential impacts on groundwater, surface water, wetlands and riparian areas, and floodplains from the development of natural gas in the proposed project area. Direct and indirect effects include: groundwater depletions; surface water depletions; degradation of surface water from potential natural gas condensate spills; degradation of surface water due to sedimentation and turbidity, salinity, and selenium; and loss of area/decrease in Proper Functioning Condition (PFC) of wetlands and riparian areas and floodplains. Impacts to the quality of deep and alluvial groundwater are not discussed in the alternatives analysis because no impacts are expected under any alternative. All wells would be cased, eliminating interactions between well holes and surrounding groundwater near the surface. Spills potentially contaminating groundwater near the surface would be contained and mitigated through applicant-committed measures dealing with hazardous materials and emergency response (Section 2.2.9). Reserve pits containing process water, drilling fluid, and drill cuttings would be lined with a synthetic liner of at least 16 mil thickness. Impacts to groundwater present in aquifers in the formations from which gas would be extracted would be negligible because surface connections in the project area are limited (UDWaR 1999) and applicant-committed measures for hazardous materials and emergency response would prevent contamination. Produced water is typically of poor quality and is high in total dissolved solids (TDS). Impacts related to its depletion and disposal are analyzed below.

4.15.1 Direct and Indirect Effects

Direct and indirect effects on water resources would be the same under all alternatives. However, impacts would vary in degree based on the number of wells and associated roads, pipelines, and other facilities proposed. Potential impacts are described in greater detail under Alternative A (Proposed Action) than under the other alternatives. Impacts associated with the Proposed Action and Alternatives B, C, E, and F are compared to the No Action Alternative.

4.15.1.1 Alternative A: Proposed Action

4.15.1.1.1 Groundwater Resources

4.15.1.1.1.1 Groundwater Depletion

No deep groundwater would be used for drilling, completion, or production activities related to this project. However, these activities would result in permanent withdrawals of groundwater (produced formation water), which would be trucked to an evaporative surface disposal facility constructed in the well field. Because produced formation water would be evaporated rather than reinjected into wells, these depletions would result in a decrease over the long term in the water stored in these aquifers. Under the Proposed Action produced groundwater would result in total aquifer drawdown of approximately 20,319 acre-feet over a 45-year project life span (30 years of production). This is 0.07% of the estimated 31 million acre-feet of water stored in aquifers in the Uinta Basin (UDWaR 1999), and represents a negligible impact on the quantity of groundwater in the area (Table 4-128). Under the Proposed Action there would be 4.1 times as much produced groundwater and resulting aquifer drawdown as there would be under the No Action Alternative (see Table 4-128).

No shallow fresh water resources are expected to be used or depleted by project activities; Because wells would be fully cased to a depth of approximately 3,500 feet, there would be no change in volume, storage, or flow of the wells and springs supported by these resources.

Table 4-128. Produced Water by Alternative for 45-year Life of Project (LOP) and Percentage Decrease in Water Stored in Uinta Basin Aquifers

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Produced water (acre-feet) over LOP (45 years)	20,319	15,181	25,715	5,015	15,181	18,040
Percentage decrease in water stored in Uinta Basin aquifers	0.07%	0.05%	0.08%	0.02%	0.05%	0.06%

4.15.1.1.1.2 Groundwater Quality

Available data indicate that TDS increases with depth, with indications that groundwater is briny or saline deeper than 200 feet in the project area (Utah Division of Natural Resources 1987); however, there are 2 springs, 1 water well, and one water tunnel in the project area used for domestic and stock purposes, which suggests the presence of limited shallow and usable fresh water zones. The risk of potential direct and indirect impacts to these usable groundwater sources that could arise during drilling activities, well construction, production, hydraulic fracturing, and disposal of produced water in the evaporation ponds are discussed below. These risks include

- risk of contamination of shallow fresh water resources during drilling from release of drilling mud to aquifer;
- risk of contamination of shallow fresh water resources during drilling from exposure to deeper saline groundwater;
- risk of contamination of shallow fresh water resources from leaks from reserve pits or from evaporation pond facilities;
- risk of contamination of shallow fresh water resources from fracturing operations from discharge of fracturing fluid; and
- risk of contamination of shallow fresh water resources from fracturing operations from cross-connection of shallow fresh water aquifers and deeper saline aquifers containing hydrocarbons.

Potential Impacts from Drilling, Construction, and Production

Potential direct and indirect impacts to usable groundwater sources from drilling, construction, and production activities under the Proposed Action would be effectively eliminated, reduced, or mitigated through the application of required and standard stipulations and lease notices and through the guidance, regulations, Onshore Oil and Gas Orders, and standard conditions of approval (COAs) discussed below.

The project area does not overlie a sole source aquifer (SSA) or a Utah Drinking Water Source Protection Zone (DWSPZ). On federal leases, usable groundwater resources are protected during drilling in accordance with BLM Onshore Oil and Gas Order No. 2, which requires that all formations containing usable quality water (≤10,000 mg/L TDS) be isolated and protected utilizing cement.

The BLM's protection of groundwater resources begins during the resource management planning process with the development of stipulations or lease notices to be applied to oil and gas leases. Stipulations and notices are attached to leases at the leasing stage when appropriate for resource protection as determined by BLM interdisciplinary specialists. The application and implementation of stipulations, lease notices, BLM regulations and Onshore Oil and Gas Orders protects groundwater resources. Per BLM standard practice, a site-specific analysis of groundwater and groundwater protection would be conducted during BLM's review of an APD. A BLM geologist and/or hydrologist would perform an independent review of each APD utilizing Utah Geological Survey (UGS) and U.S. Geological Survey (USGS) geologic and hydrologic data and maps to generate a geologic report. The geologist and/or hydrologist would identify usable groundwater and mineral-bearing zones that require protection, including SSAs and DWSPZs. A petroleum engineer would review the casing and cementing portions of the drilling plan to ensure the protection of those zones identified by the geologic report. A natural resource specialist (NRS) would review the surface use plan and determine the adequacy of reserve pit design. COAs would be attached to the APD as necessary.

Operators are encouraged to substitute less toxic (chromate, lead, etc.), yet equally effective chemicals, for conventional drilling products such as mud and pipe dope. To prevent contamination of groundwater and soils, or to conserve water, the BLM suggests that operators line reserve pits with an impermeable liner if pits are constructed in areas of shallow groundwater or in porous soils over fractured bedrock. The BLM suggests that operators use a closed-loop drilling system in areas of porous soils, over fractured bedrock, when drilling through a DWSPZ or SSA, or in areas of shallow groundwater. BLM does not have a standard definition for shallow groundwater or porous soils over fractured bedrock as referenced in the Gold Book. Thus, final determination for potential impact to shallow groundwater is site-specific and is assessed during the on-site. At that time the occurrence of porous soils and subsequent permeability (hydraulic conductivity) would be assessed by the BLM. If depth to groundwater in unknown and groundwater is not encountered during construction of the reserve pit then review of the borehole logs, for setting the conductor pipe (approximately 40 feet deep) and setting the surface casing (several hundred to several thousand feet), would be used to determine the potential to impact groundwater. Gasco has indicated that closed-loop drilling systems are viable for shallow depths and shallow wells, such as wells completed in the Green River Formation; however, closed-loop drilling systems for wells drilled into the Mesaverde and deeper formations are generally not a viable option due to the difficulties involved in removing liquid from the cuttings and hauling cuttings. If the AO determines it is necessary, as verified during the on-site or permit review, the BLM would make this a requirement by attaching a COA at the time of APD approval. The BLM has the authority to require companies to do reasonable testing, if deemed necessary, in accordance with 43 CFR 3162.4-2.

Groundwater zones would be protected by cementing the surface casing to the ground surface and also bringing the cement for the production or intermediate casing to at least 200 feet above the surface casing shoe. At a minimum, Gasco expects to install surface casing to a depth of approximately 200 feet, with cement extending from the total depth of the surface casing to the ground surface. The surface casing is intended to protect any fresh water aquifers present, as well as act to contain abnormal pressure during further drilling. Low toxicity mud will be used for the initial drilling through this zone. Once cased to at least 200 feet, the well would then be drilled to a depth of at least 3,500 feet. A second surface casing would be installed and cemented to a depth of at least 3,500 feet. As necessary, a COA would be attached to the APD. The COA would specify the anticipated formation and depth where usable quality water might be encountered. Petroleum engineering technicians (PETs) would inspect well sites during drilling, completion, and production for technical and safety compliance. The BLM will require the operator to conduct cement bond log surveys to verify cement adequacy.

Potential Impacts from Disposal of Produced Water

Potential direct and indirect impacts to usable groundwater sources from disposal of produced water in evaporation ponds under the Proposed Action would be effectively eliminated, reduced, or mitigated through the application of required and standard stipulations and lease notices and through the guidance, regulations, Onshore Oil and Gas Orders, and standard COAs discussed below.

Onshore Oil and Gas Order No. 7, Disposal of Produced Water (43 CFR 3162.5 – Environment and Safety) specifies the information and procedures required to submit an application for the disposal of produced water, and the design, construction, and the maintenance required for disposal pits. All produced water from federal leases must be disposed of as follows: 1) by injection into the subsurface, which is regulated by the EPA or UDOGM within the underground injection control (UIC) programs; 2) into pits [evaporation basins], which is regulated by BLM or UDOGM; or 3) by other acceptable methods approved by the AO, including surface discharge under the National Pollutant Discharge Elimination System (NPDES) as regulated by Utah Division of Environmental Quality (UDEQ). Injection of produced water on federal lands in Utah is regulated by Utah Administrative Rule R649-5: Underground Injection Control of Recovery Operations and Class II Injection Wells. Injection of produced water on Indian lands in Utah is administered by the EPA under 40 CFR 17.2253.

Containment structures would be constructed around all tank batteries and would be consistent with EPA's spill prevention control and countermeasure (SPCC) regulations. All spills or leakages must be reported immediately by the operator to the BLM in accordance with Notice to Lessees (NTL) 3A.

Assuming that the evaporative basins would receive waters from wells located on state and private lands, siting and permitting of evaporative basins would be regulated by both BLM and UDOGM during the site-specific permitting process. Permitting of evaporative basins includes both engineering and programmatic conditions intended to prevent impacts to fresh water resources. From an engineering perspective, BLM and UDOGM would require compliance with all specifications contained in Utah Administrative Code R649-9 Waste Management and Disposal, which require that evaporative basins be lined, have secondary containment, and have a leak detection system, as detailed in Section 2.2.4. Programmatically, the UDOGM permitting process focuses on selecting suitable sites for evaporative basins rather than relying on engineered controls. Based on site-specific geotechnical and drilling information submitted during the permitting process, BLM and UDOGM will determine the potential presence of any fresh water resources. If fresh water resources are present, the site is generally considered unsuitable for siting evaporative basins (personal communications between Brad Hill, Utah Division of Oil, Gas, and Mining, and Chris Garrett, SWCA, April 26, 2011, and with Greg Larson, SWCA on October 20, 2011). The above regulatory requirements are intended to prevent impacts to fresh water resources from evaporative disposal ponds.

Potential Impacts from Hydraulic Fracturing

Potential direct and indirect impacts from hydraulic fracturing include the release of contaminants due to loss of fracturing fluids during active fracturing procedures and the potential for fracturing to create pathways for migration of poor quality water, gases, or other contaminants into shallow fresh water aquifers.

The fracturing fluids to be used in the project area are water-based and are considered to be low-toxicity when used in proper concentrations, as described in Section 2.2.2.4. No diesel fuel would be used for hydraulic fracturing. Release of the fracturing fluid is controlled through the fracturing process. Once a well is hydraulically fracture stimulated, the fracturing fluid is produced back to a tank within a closed-loop system. A recent EPA study found that approximately 15%–80% of the fluid injected is recovered after use (EPA 2011d). The fracturing fluid should never go to the reserve pit. The fluid is then transported via water trucks to the recycling and or evaporative pond facilities and can be reused for future drilling and completion operations.

All formations react differently to fracturing depending on the practices, pressures, and fluids used. Previous studies in relatively shallow coal beds found that induced fractures can extend up to 870 feet from boreholes, with additional extension caused by tie-in with natural fractures (EPA 2004b). Based on available information on water quality and water users in the area, it is likely that fresh water resources occur only in shallow formations less than 200 feet deep. Production wells are planned to be drilled from 5,000 to 13,000 feet. Therefore there is likely to be at least 4,000–5,000 vertical feet of separation from the fracturing zone of the producing wells and any potential shallow fresh water resources.

A recent study released in April 2011 analyzed the effects of gas well drilling and hydraulic fracturing in the Marcellus shale of northeastern Pennsylvania and upstate New York (Osborn et al. 2011). Based on statistical analysis of methane and hydrocarbons in groundwater samples from drinking water wells in active drilling areas and non-active areas, this report concluded that there is a statistical evidence for elevated methane concentrations in drinking water wells in active drilling areas; however, no evidence was found for migration of fracturing fluids into drinking water wells. The drinking water wells in the study ranged from 120 to 620 feet deep, with an average vertical separation from the Marcellus shale of approximately 3,000 to 6,000 feet. The authors concluded that the most likely mechanism for methane migration was leaky well casings rather than migration of fractures over this vertical distance, although both mechanisms were considered possible.

Based on the available studies, it is considered possible but unlikely for fractures to migrate vertically a great enough distance to impact any shallow fresh water resources, if those resources are present. The potential impact to fresh water resources from hydraulic fracturing is minimal.

4.15.1.1.2 Surface Water Resources

Direct and indirect effects of natural gas development on surface waters (quantity and quality) are discussed below. Subsequent effects on wildlife and special status species are discussed in Section 4.16, Wildlife, and Section 4.12, Special Status Species.

4.15.1.1.2.1 Surface Water Use

Of the total water needs for drilling, completion, and production activities, approximately 6% would come from sources tributary to the Green River, and would therefore be considered Green River depletions. Over the 45-year duration of the project under the Proposed Action, the total water needs (for drilling, completion, and production) would be approximately 4,439 acre-feet including approximately 288 acre-feet of fresh water for cementing casing strings, rig washing, and other drilling- and construction-related activities. Water is primarily used during the drilling and completion phases (within a year of drilling); therefore consumptive water use would reach a maximum of approximately 23 acre feet per year during the first 15 years of the project. Assuming this quantity of water would otherwise reach the Green River, it is possible to estimate the percentage annual decrease in Green River flows (where average annual flow is approximately 4,064,290 acre-feet at Ouray, Utah [BLM 2006b]) as a result of these annual withdrawals from Green River tributaries (Table 4-129). Under the Proposed Action, the maximum withdrawals of 23 acre-feet per year would have a negligible impact on flows in the Green River, where mean annual flow would decrease by approximately 0.000006%. Annual withdrawals from the Green River Basin under the Proposed Action would be approximately 4.1 times the withdrawals under the No Action Alternative (see Table 4-129).

Table 4-129. Withdrawals (acre-feet) from Green River Tributaries and Sources by Alternative

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Total withdrawals (acre-feet)	288	215	365	71	215	251
Peak annual withdrawals (acre-feet) over 15-year drilling phase of project[1]	23.20	23.20	23.20	5	23.20	23.20
Percentage decrease in Green River flow as result of peak withdrawals	0.000006%	0.000006%	0.000006%	0.000001%	0.000006%	0.000006%

[1]Peak annual withdrawals for Alternatives A, B, C, E, and F are calculated using Gasco's projected peak well construction rate of 120 wells/year. Production rate for the No Action Alternative would depend on the permitting schedule for several individual projects. Peak withdrawal has been therefore averaged for all 15 years of drilling.

4.15.1.1.2.2 Surface Water Quality

Sediment, Turbidity, and Temperature

Increased sedimentation and turbidity of surface waters would be anticipated from project-related activities. Where roads cross ephemeral washes, erosion would generally increase, resulting in the delivery of sediments directly to the ephemeral wash. Erosion and sediment delivery to intermittent/ephemeral stream courses would also result in long-term impacts due to project-related traffic disturbing road surfaces, erosion around the crossing during infrequent flow events, and subsequent delivery of sediments to adjacent ephemeral streams. Any increase in sedimentation or turbidity could have a direct impact upon water temperature. Nine Mile Creek was first listed on Utah's 2006 303(b) list of impaired waterways for cold water aquatic life beneficial use designation (3A) due to high temperature (UDEQ 2010a; Map 29). As water increases in total suspended solids (TSS) or turbidity, it increases the amount of solar radiation it can absorb, therefore increasing in temperature (Poole and Berman 2000). However, the Utah Division of Water Quality (UDWQ) is in the process of changing the designated use for Nine Mile Creek from cold water aquatic life (use designation 3A) to warm water aquatic life (use designation 3B) (personal communication between Erica Gaddis, SWCA, and Carl Adams, UDWQ, January 2011).

Sediment erosion and delivery due to road crossings is difficult to quantify because conditions at the proposed road crossings are quite variable. However, an estimate of the number of road crossings by alternative provides for a relative comparison of sedimentation and turbidity between alternatives. Under the Proposed Action, approximately 568 road crossings would occur across the project area (Table 4-130). There would be 4 times more road crossings under the Proposed Action than under the No Action Alternative, resulting in greater sedimentation and turbidity impacts due to road crossings of ephemeral streams (see Table 4-130).

Table 4-130. Road Crossings of Ephemeral Streams under Each Alternative

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Road crossings of ephemeral streams	568	440	805	153	190	384

Other surface disturbances, including well pads, roads, and pipelines across the project area, as well as construction of a WEF, would also increase erosion and sediment yield. Under the Proposed Action, an estimated 7,584 acres of surface disturbance from road, pipeline, well pad, and WEF construction would result in approximately 539,593 tons (Table 4-131) of additional erosion above background rates over the 30-year life of the project (for sediment yield calculations see Section 4.10.1.1.3). Soil eroded from the landscape may reach ephemeral drainages in the project area and be transported downstream to the Green River. In sufficient amounts sediment can clog stream channels; increase turbidity within streams; and may carry other pollutants such as metals, pesticides, and excess nutrients (i.e., nitrogen). However, stream channels in the region of the project area generally carry high sediment loads during infrequent high flow events, and the Proposed Action would increase the sediment load of the Green River by less than 1% (see Table 4-131).

Table 4-131. Estimated Additional Erosion and Sediment Delivery to Drainages and the Green River by Alternative

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Surface disturbance (acres)	7,584	5,528	9,711	1,998	2,174	3,602
Tons of additional erosion (LOP)[1]	539,593	531,797	682,905	133,179	136,382	239,085
Estimated delivery of sediment (tons) to watershed drainages eventually reaching the Green River (LOP)	107,919	106,359	136,581	26,636	27,276	47,817
Estimated Percentage increase in annual sediment loading to Green River[2]	0.03%	0.03%	0.04%	0.01%	0.01%	0.01%

[1] Assumed that runoff form the project would extend for 34 years to account for the 30-year life of the project and 4 years of reclamation (see Section 4.10.1.1.3).
[2] Assumed that current sediment load to Green River is 9,684,000 tons per year.

Assuming that 20% (see Section 4.10.1.1.3) of the 539,593 tons of eroded soil reached ephemeral drainages in the project area, sediment loading to these drainages would increase by 107,919 tons over the life of the project. Once delivered to ephemeral drainages, the sediment would be more readily transported to the Green River. Assuming that all 107,919 tons of additional sediment eventually reached the Green River, where existing sediment loading (at Jensen, Utah) is approximately 9,684,000 tpy (BLM 2005b), the increase in sediment delivered to the Green River over the life of all wells would be approximately 0.03% (see Table 4-131). It should be noted that the actual amount of sediment delivered is likely to be less than 20% of the total estimated due to soil deposition onto adjacent undisturbed areas and stormwater pollution prevention measures (outlined under Section 4.15.2, Mitigation). Overall, the short- and long-term impacts to the Green River of increased sediment under the Proposed Action would be relatively low. Still, the Proposed Action would result in 4.1 times as much sediment delivery to the Green River as under the No Action Alternative.

Lower and Upper Pariette Draw and Nine Mile Creek, the only other perennial streams in or adjacent to the project area, would also be impacted by increased sediment delivery. Data on background sediment yield to these streams are not available. However, it is possible to estimate the total increase in sediment yield to these streams from project-related activities. Estimates are based on the number of wells that would be sited in each watershed assuming 362 tons of increased sediment yield per well above background rates (see Section 4.10.1.1.3 for sediment yield calculations; Table 4-132). Under the Proposed Action, there would be approximately 19,331 tons of sediment delivered to Lower Nine Mile Creek over background sediment delivery. This is 10.3 times more sediment delivery to Lower Nine Mile Creek than would occur under the No Action Alternative. Approximately 11,439 tons of sediment would be delivered to Lower Pariette Draw and 11,005 tons to Upper Pariette Draw, 1.8 times and 3.5 times more than under the No Action Alternative, respectively. Sheep Wash-Green River would be subjected to approximately 66,174 tons of sediment delivery over background 4.3 times more than under the No Action Alternative (see Table 4-132).

Table 4-132. Estimated Sediment Erosion and Delivery to Project Area Drainages (above Background Rates) under Each Alternative

Watershed	Disturbance	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Lower Nine Mile Creek	Number of well pads	267	143	311	26	44	144
	Estimated erosion (tons)	96,654	51,766	112,582	9,412	18,304	59,904
	Estimated sediment delivery (tons)	19,331	10,353	22,516	1,882	3,661	11,981
Lower Pariette Draw	Number of well pads	158	133	393	87	43	68
	Estimated erosion (tons)	57,196	48,146	142,266	31,494	17,888	28,288
	Estimated sediment delivery (tons)	11,439	9,629	28,453	6,299	3,578	5,658
Upper Pariette Draw	Number of well pads	152	152	220	43	46	80
	Estimated erosion (tons)	55,024	55,024	79,640	15,566	19,136	33,280
	Estimated sediment delivery (tons)	11,005	11,005	15,928	3,113	3,827	6.656
Sheep Wash–Green River	Number of well pads	914	686	963	212	197	283
	Estimated erosion (tons)	330,868	248,332	348,606	76,744	81,952	117,728
	Estimated sediment delivery (tons)	66,174	49,666	69,721	15,349	16,390	23,546

Salinity, Selenium, and Boron

The UDWQ determined that Pariette Draw is not supporting its agricultural use due to violations of water quality criterion for elevated boron and TDS concentrations. Pariette Draw is also listed as not supporting its warm water fisheries and waterfowl classification due to exceeding the chronic standard for selenium (see Section 3.15.3.3.2). Increased levels of salinity and selenium can be a concern in fresh water due to their impact on wildlife above certain concentrations, especially fish and waterfowl (EPA 2007c). The potential impacts of selenium on special status fish are discussed in Section 4.12.

The project will comply with storm water regulatory requirements that mandate use of BMPs to minimize impacts to water quality. The Utah and EPA stormwater permitting processes, UPDES and NPDES respectively, for construction activities and oil and gas operations will ensure consistency with the approved Total Maximum Daily Load (TMDL) for Pariette Draw and compliance with Utah Water Quality Standards (UDEQ 2008). EPA regulates storm water on the Uintah and Ouray Reservation in the project area through the NPDES General Construction Permitting process. The Utah Division of Water Quality regulates all other storm water in the project area through the UPDES permitting process.

There would be no direct discharges of selenium, boron, or other criteria pollutants associated with the project. Construction and development activities could result in increased sedimentation and runoff which in turn could increase sediment loading during runoff-producing storm events. Selenium, boron, or other substances contained in or absorbed onto sediments can be transported into the surface waters along with the sediment and impact water quality. It is difficult to quantify potential increases in salinity, selenium, and boron concentrations in surface waters in and adjacent to the project area because these constituents would largely be derived from runoff from project area soils, and soil concentrations of these constituents vary widely across the landscape. However, soils are classified based on rehabilitative or restrictive soil features, one of which is excess salt. Runoff from these soils could result in increased salinity. Under the Proposed Action approximately 547 acres of disturbance would occur in areas where excess salt is present as a restrictive feature. This represents 7.2% of the total area of surface disturbance under the Proposed Action (Table 4-133). Approximately 4.1 times more surface disturbance would occur where excess salt is present as a restrictive feature under the Proposed Action than under the No Action Alternative. Selenium is mostly concentrated in soils that have experienced irrigation in the past. No well pads would be located on formerly or currently irrigated soils under any of the alternatives, including the Proposed Action.

Table 4-133. Acres (and Percent) of Disturbance in Soils with Excess Salts

Restrictive Feature	Degree of Restriction	Acres Disturbed (% of Total Area Disturbed)					
		Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Excess Salt	Highly restrictive	165 (2.2%)	111 (1.9%)	213 (2.1%)	33 (1.6%)	43 (2.0%)	77 (2.1%)
	Moderately restrictive	382 (5.0%)	183 (3.2%)	468 (4.7%)	101 (4.9%)	64 (2.9%)	69 (1.9%)
Total		547 (7.2%)	294 (5.2%)	682 (6.8%)	134 (6.5%)	107 (4.9%)	146 (4.0%)

Although surface disturbance associated with oil and gas development has the potential to increase erosion and sediment transport to surface waters, the analysis discussed below demonstrates that there is no apparent relationship between water quality parameters of concern (TSS, TDS, selenium, and boron) and oil and gas development at the watershed scale (e.g., in Antelope Creek). Thus, the project would not be expected to contribute measurably to existing impairments of surface waters in the area.

The USGS determined that land disturbance associated with oil and gas development in the Upper Colorado River Basin was not a statistically significant factor in predicting dissolved solids in local surface waters (Buto et al. 2010). This finding is supported by a conceptual model of dissolved solids transport also developed by the USGS (Kenney et al. 2009). One large limitation of this study was the application of a relatively small dataset to a very large river basin. Although the USGS study recognized that there is a connection between sediment and TDS, surface erosion (the process affected by land disturbance) is not a primary pathway for dissolved solids transport from the landscape to surface waters in the Upper Colorado River Basin; nor is surface erosion the primary transport pathway for selenium and boron. Rather, the primary pathways for selenium are most likely from irrigation drainage on irrigated lands and groundwater transport. The project area does not overlie formerly irrigated lands in the watershed and would therefore not be likely to measurably exacerbate existing selenium runoff from agricultural sources. Groundwater transport appears to be the primary transport mechanism for boron, though there is more uncertainty associated with specific transport pathways of this pollutant.

The relationship between oil and gas development and water quality was investigated for the Pariette Draw watershed using regression analyses (least squares method). There has been substantial oil and gas development in the Pariette Draw watershed since 1993 and water quality data are available across this period. The following EPA Storage and Retrieval sites were included in the analysis: 4933440 (Pariette Draw 1 mile above confluence with the Green River), 4933480 (Pariette Draw 0.33 mile above flood control dam), and 4933476 (Pariette Draw below flood control dam). Precipitation (annual and three year cumulative) data were also included in the regression model to eliminate it as a confounding variable. Between 1993 and 2007 the total number of oil and gas wells in the Pariette Draw watershed increased from 423 wells to 2,587 wells. However, despite this increase in well development, there was no statistically significant relationship between the number of wells and concentrations of TDS, total suspended solids (TSS), boron, or selenium.

Spills Potentially Contaminating Surface Waters

Natural gas pipelines in the project area would contain natural gas condensate. If a pipeline were to leak or rupture it is possible that condensate could drain into nearby ephemeral and perennial streams. Natural gas condensate is known to be acutely toxic in quantities equal to or greater than 7.4 ppm (BLM 2005b). This acute toxicity makes potential spills of natural gas condensate a surface water quality concern.

The toxicity of an accidental natural gas condensate spill to a particular stream or river would depend on the amount spilled, the level of attenuation before reaching the water, and the flow volume (and dilution) of the stream or river. Natural gas condensate is highly volatile and likely to evaporate within approximately 8 hours of spilling (BLM 2005b). Thus, spills occurring in close proximity to streams would potentially result in lethal levels of toxic substances. Because the crude oil extracted in the project area is solid within the temperature range of the area's climate, oil would not pose a risk of acute toxicity in the event of an accidental spill. Pipelines contain more natural gas condensate than wells and their associated tanks. Therefore, the risk from pipelines is assumed to be greater than that from wells, and is the primary focus of this analysis.

The risk of spills potentially contaminating surface waters is proportional to the length of pipeline present and the number of pipeline stream crossings; the greater the length of pipeline proposed, and the greater the number of pipeline stream crossings proposed, the greater the risk. An additional factor is the distance from a perennially flowing waterway to the closest pipeline stream crossing. The closer a pipeline stream crossing is to a perennially flowing waterway, the higher the risk of a spill reaching and contaminating that waterway. In conjunction with the spill risk assessment as described below, these factors can be compared across alternatives to determine the relative risk of a spill contaminating surface waters. Under the Proposed Action, there would be approximately 431 miles of pipeline and 743 pipeline stream crossings (Table 4-134). The distance from the closest pipeline stream crossing to a perennially flowing waterway (the Green River, Pariette Draw, or Nine Mile Creek) varies under the Proposed Action between 1.07 miles (to Nine Mile Creek) and 1.47 miles (to Pariette Draw). The closest pipeline stream crossing to the Green River is 0.83 mile (Table 4-135). There would be approximately 1.4 times the number of pipeline miles and 1.6 times the number of stream crossings under the Proposed Action than under the No Action Alternative. The closest pipeline stream crossing to the Green River is approximately the same under both the Proposed Action and No Action, although the closest pipeline stream crossings to Pariette Draw and Nine Mile Creek are considerably closer under the Proposed Action than under the No Action Alternative (see Table 4-135). The risk of a pipeline spill of natural gas condensate potentially contaminating surface waters would be greater under the Proposed Action than under the No Action Alternative.

Table 4-134. Miles of Pipeline and Pipeline Stream Crossings by Alternative

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Pipeline miles	431	393	861	316	216	316
Pipeline stream crossings (number)	743	600	1,253	473	347	744

Table 4-135. Closest Pipeline Stream Crossing to Perennial Streams (Miles) under Each Alternative

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Green River	0.83	0.80	0.82	0.81	0.80	1.1
Pariette Draw	1.47	13.21	0 (crosses)	3.04	12.71	1.2
Nine Mile Creek	1.07	0.16	0.14	4.68	2.90	0.6

The BLM analyzed the risk of toxicity to endangered fish from potential spills into Pariette Draw and its tributaries in the Final EIS and ROD for the Castle Peak and Eightmile Flat Oil and Gas Expansion Project (BLM 2005b). That study used conservative assumptions that provide a conservative spill risk assessment for analysis. The worst case scenarios used in the Final EIS of spills directly into the Green River (via Sheep Wash) and into Lower Pariette Draw (which is a direct tributary to the Green River) are applied to this analysis and would constitute the worst case scenarios for the Proposed Action and other alternatives.

Assuming full draindown of 1.5 miles of unpigged 3-inch transmission pipeline, approximately 2,660 gallons of condensate would be released in the event of a spill. Further assuming that 1% of this total was composed of the toxic aromatic hydrocarbon component of condensate, and that the spill was unattenuated (i.e., 100% reached the river in a single slug), the Final EIS and ROD for the Castle Peak and Eightmile Flat Oil and Gas Expansion Project concluded that a spill directly into the Green River or a tributary to the Green River would not result in acutely toxic concentrations in the Green River, even under very low flow conditions (BLM 2005b). With the Green River flowing at only 828 cfs, such a spill would result in a concentration of approximately 0.7 ppm, or approximately 10% of the toxic threshold of 7.4 ppm. Using that document's analysis, it can be conservatively assumed that a spill of 2,660 gallons or more would reach toxic concentrations only when flows in the Green River (or a smaller stream) are at or below approximately 79 cfs. This is well below the lowest recorded stream flow in the Green River. Furthermore, due to applicant-committed measures, including the use of shutoff valves where applicable (which would reduce the length of a pipeline spill to well below 1.5 miles) and the burial of pipelines at least 3 feet below all stream crossings, the risk of a pipeline spill reaching toxic concentrations in the Green River would be very low. In addition, applicant-committed BMPs for the site-specific use of buried pipelines and centralized water and condensate tank facilities would reduce the risk of spills from pipelines and tanks where appropriate. Due to their smaller flows, Pariette Draw, Nine Mile Creek, and other small tributaries to the Green River would be at greater risk of toxic concentrations of natural gas condensate following an accidental release, though applicant-committed measures as described would also reduce the risk of toxic concentrations of natural gas condensate in these water bodies.

The likelihood of a spill is independent of an accidental spill's toxicity, as described above. Applying the historical national average for pipeline accidents of 0.001 incidents/mile/year (OPS 2002), the 1.3 miles of pipeline in the Green River floodplain under the Proposed Action would carry a risk of 0.039 incidents over the 30-year production phase (over which each pipeline would be used), or one incident every 764 years. Thirteen miles of pipelines crossing floodplains within 5 miles of the Green River would carry a risk of 0.39 incidents over the 30-year production phase of the project, or one incident every 77 years. By comparison, under the No Action Alternative there would be 0.6 mile of pipeline in the Green River floodplain resulting in a risk of 0.018 incidents over the 30-year production phase of the project, or one incident every 1,678 years. Within 5 miles of the Green River there would be 7.5 miles of pipelines crossing floodplains resulting in a risk of 0.22 incidents over the 30-year production phase of the project, or one incident every 133 years. Attenuation of spills upstream of the Green River floodplain would be considerable, however, and in 80% of pipeline spills, less than 8.5% of the pipe's volume is actually released (CSFM 1993). Therefore, spills large enough to reach the Green River would have a risk of occurring far less frequently than every 77 or 133 years as under the Proposed Action and the No Action Alternative, respectively (Table 4-136).

Table 4-136. Miles of Pipeline and Risk of Pipeline Incidents by Alternative

Floodplains within 5 Miles of Green River	Pipeline miles, probable incidents, years per probable incident	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Desert Springs Draw	Miles	2.1	1.6	5.5	2.3	2.8	0
	Incidents	0.064308	0.048432	0.165233	0.069895	0.082686	0
	Years / incidents	467	619	182	429	363	N/A
Eightmile Flat	Miles	0.6	0.2	1.8	0.9	0.0	0
	Incidents	0.017849	0.006598	0.054672	0.026585	0	0
	Years / incidents	1681	4547	549	1128	n/a	N/A
Four Mile Creek	Miles	2.8	2.5	7.4	3.6	1.5	0
	Incidents	0.083718	0.075843	0.222337	0.109015	0.045735	0
	Years / incidents	358	396	135	275	656	N/A
Green River	Miles	1.3	1.5	1.8	0.6	0.6	0
	Incidents	0.039276	0.045685	0.05526	0.017883	0.017222	0
	Years / incidents	764	657	543	1678	1742	N/A
Pariette Draw	Miles	0.5	0.0	0.3	0.0	0.0	0
	Incidents	0.013975	0	0.009927	0	0	0
	Years / incidents	2147	n/a	3022	n/a	n/a	N/A
Sand Wash	Miles	4.2	4.2	5.4	0.2	4.2	0
	Incidents	0.126868	0.126868	0.161957	0.005698	0.126868	0
	Years / incidents	236	236	185	5265	236	N/A
Sheep Wash	Miles	2.8	2.5	4.3	0.5	2.4	0
	Incidents	0.084201	0.075774	0.128365	0.013646	0.07059	0
	Years / incidents	356	396	234	2198	425	N/A
Total miles of pipelines in floodplains within 5 miles of the Green River*	Miles	13	11	24.7	7.5	10.9	0
	Incidents	0.39	0.33	0.74	0.22	0.33	0
	Years / incidents	77	90	40	133	92	N/A

*Does not include the miles of pipeline within the Green River floodplain itself.

Due to high levels of salts and the presence of chemicals related to the natural gas drilling and production process, spills from the WEF are, like spills of natural gas condensate from pipelines, a surface water quality concern. However, all WEF, regardless of alternative, would be constructed and operated to meet all stipulations outlined in BLM Onshore Order #7. These stipulations include double-lining of the WEF, the installation and operation of a leak detection system, and prevention of surface water ingress or discharges to surface waters. Because of these stipulations, potential impacts to surface waters would have an extremely low risk of occurring. However, in the unlikely event of a spill from a WEF, impacts to surface water bodies include the introduction of water from source aquifers, hydraulic fracturing fluids, and other constituents associated with the drilling process. Potential contaminants include trace metals (e.g., lead and mercury), inorganic constituents (e.g., arsenic, boron, and ammonia), and organic constituents (e.g., volatile organic compounds and petroleum hydrocarbons).

Assuming that greater surface area of evaporative facilities leads to greater risk of a spill from evaporative ponds, it is possible to assess the risk of the direct, adverse, short-term effects on surface water under each alternative. Under the Proposed Action approximately 143 acres of evaporative facilities would be built in the northeastern portion of the project area. This is approximately 3 times more area devoted to evaporative facilities than under the No Action Alternative where 57 acres of evaporative facilities would be built (Table 4-137).

Table 4-137. Acres of Evaporative Facilities under Each Alternative

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Acres of evaporative facilities	143	135	271	57	135	78

4.15.1.1.3 Wetlands and Riparian Areas

Wetlands and riparian areas comprise a small portion (1,249 acres or 0.6%) of the 206,826-acre project area. Utah BLM Riparian Policy (UT-93-93) is to maintain and/or improve riparian areas to Proper Functioning Condition (PFC). Accordingly, no new surface disturbing activities are allowed within 330 feet of riparian areas unless

1) there are no practical alternatives,
2) all long-term impacts can be fully mitigated, or
3) the new surface disturbing activity would benefit or enhance the riparian area.

Under the Proposed Action, project-related activities would result in approximately 11 acres of surface disturbance in riparian areas, consisting of 0.1 acre of pipeline disturbance, 1.4 acres of pipeline and road disturbance, and 9.2 acres of well-pad disturbance. By comparison, no project-related activities, and therefore no surface disturbance, would occur in wetlands and riparian areas under the No Action Alternative (Table 4-138).

Surface disturbance in wetland and riparian areas would result in the long-term loss of riparian vegetation in these areas and provide opportunities for noxious weeds and undesirable plants to invade. The invasion of noxious weeds and undesirable plants decreases the available area for desirable wetlands species, which results in an overall decrease in the diversity of wetlands vegetation and a decrease in the functional value of the wetland area (decline in PFC) for wildlife species that use riparian areas as habitat.

Table 4-138. Acres of Disturbance (and Percentage of Total Riparian Area Present) in Riparian Areas by Alternative

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Riparian area disturbance	11 (0.88%)	0 (0%)	4 (0.32%)	0 (0%)	0 (0%)	0 (0%)

Wetlands and riparian areas may be indirectly impacted by project activities when disturbance in upland areas results in runoff that contributes sediment and debris to these areas. Also see the Sedimentation and Turbidity discussion above for a relative assessment of these impacts by alternative. Water and soils in wetlands and riparian areas would also be at risk of contamination by spills of natural gas condensate and spills from evaporative facilities. These risks are discussed above under Spills Potentially Contaminating Surface Waters.

4.15.1.1.4 FLOODPLAINS

Replacement of the natural contours and vegetation of floodplains with contoured roads, pipelines, and well-pad facilities would result in altered floodplain conditions that would inhibit function. Wells and well pads placed within the floodplain would block or channelize flood flows during a large-scale flood event. Also, well pads and associated facilities would be susceptible to flood damage. Further, construction of roads and facilities within the floodplain would result in greater soil erosion and sediment yield to adjacent water bodies (ephemeral and perennial) and there would be an increased risk of accidental spills in case of a major flood event. Acres of disturbance and well pads sited in the 100-year floodplain (Table 4-139) are good measurements of these potential impacts. Under the Proposed Action, 223 acres of disturbance would occur in the 100-year floodplain, including 48 well pads and approximately 8.4 miles of road and pipeline. Approximately 3.5 times more disturbance would occur; more than 4 times more well pads would be sited in the 100-year floodplain; and approximately 2 times more road and pipeline would be constructed under the Proposed Action than under the No Action Alternative.

In accordance with Executive Order 11988, federal agencies are required to make decisions in a manner that promotes avoidance of adverse impacts and reduces the risk of property loss and human safety due to floodplain development and/or modification, and preserves the natural and beneficial values of floodplains. Development and/or modification in floodplains is only allowed if there are no feasible alternatives. Due to the programmatic nature of this document, exact locations of well pads, pipelines, and roads are not known at this time and the above estimates of future potential impacts (see Table 4-139) have been made using the best available data. On-site review, at a later date, would determine if individual well pads would be allowed within the 100-year floodplain. This analysis would require that any proposed work comply with Executive Order 11988.

Table 4-139. Acres of Disturbance in the 100-year Floodplain by Floodplain and in Total; Well Pads Sited in the 100-year Floodplain

Floodplain Name	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Desert Springs Draw	37	36	41	12	9	0
Eightmile Flat	26	6	42	9	<<1	0
Four Mile Creek	32	27	54	9	16	0
Green River	50	39	20	18	11	0
Nine Mile Creek	1	0	1	0	0	0
Pariette Draw	17	0	4	0	0	0
Sand Wash	6	6	8	0	6	0
Sheep Wash	52	36	62	14	22	0
Wells Draw	2	2	6	1	1	0
Total disturbance (acres)	**223**	**152**	**238**	**63**	**65**	0
Well pads in 100-year floodplain (number)	**48**	**32**	**42**	**11**	**10**	0
Miles of road and pipeline in 100-year floodplain	**8.4**	**6.3**	**16.2**	**4.4**	**5.6**	0

4.15.1.2 Alternative B: Reduced Development

Under Alternative B, the number of wells developed would be 1,114 and well-pad locations would be precluded from some sensitive areas.

4.15.1.2.1 Groundwater Resources

4.15.1.2.1.1 Groundwater Depletion

Drilling, completion and production activities in the project area would result in approximately 15,181 acre-feet of produced groundwater for the 45-year life of the project (30 years of production) under Alternative B (see Table 4-128). This is approximately 3 times more than under the No Action Alternative. The percentage decrease in water stored in Uinta Basin aquifers under Alternative B would be approximately 0.05%, or approximately 3 times more than the percentage decrease under the No Action Alternative (0.02% decrease in water stored in Uinta Basin aquifers).

4.15.1.2.1.2 Groundwater Quality

Under Alternative B, impacts to groundwater quality would be the same as described under the Proposed Action. Potential direct and indirect impacts to usable groundwater sources would be effectively eliminated, reduced, or mitigated through the application of required and standard stipulations and lease notices and the below guidance, regulations, Onshore Oil and Gas Orders, and standard COAs.

4.15.1.2.2 Surface Water Resources

4.15.1.2.2.1 Surface Water Use

Under Alternative B surface water withdrawals from the Green River Basin would be 215 acre-feet over the 45-year life of the project, and would reach a peak of 23 acre-feet per year during the initial 15-year drilling and completion phase. This is approximately 144 more acre-feet (or 3 times more) than under the No Action Alternative. The percentage decrease in Green River flows as a result of surface water withdrawals would be approximately 0.000006% under Alternative B, compared to 0.000001% under the No Action Alternative (or 3 times greater peak withdrawals; see Table 4-129).

4.15.1.2.2.2 Surface Water Quality

Sediment, Turbidity, and Temperature

The nature of water quality impacts associated with sediment, turbidity, and temperature would be similar to those described for the Proposed Action (see Section 4.15.1.1.2.2). Sedimentation and turbidity of surface waters would be increased under Alternative B compared to the No Action Alternative. Under Alternative B there would be approximately 4 times more road crossings (440 total road crossings) of intermittent/ephemeral streams (see Table 4-130) and approximately 4 times more sediment delivery (106,359 total tons of sediment) to the Green River as a result of well-pad development than under the No Action Alternative (see Table 4-131). Sediment delivery to drainages of Lower Nine Mile Creek, Lower Pariette Draw, Upper Pariette Draw, and Sheep Wash-Green River would be approximately 5.5 times (10,353 total tons under Alternative B), 1.5 times (9,629 total tons under Alternative B), 3.5 times (11,005 total tons under Alternative B), and 3.2 times (49,666 total tons under Alternative B) more, respectively, under Alternative B than under the No Action Alternative (see Table 4-132).

Salinity, Selenium, and Boron

The nature of water quality impacts associated with salinity, selenium, and boron would be similar to those described for the Proposed Action (see Section 4.15.1.1.2.2). Under Alternative B, there would be approximately 294 acres of disturbance in soils with excess salt. This is approximately 2.2 times more disturbance in soils with excess salts than under the No Action Alternative (see Table 4-133). This would result in increased concentrations of salts and selenium in surface waters compared to the No Action Alternative.

Spills Potentially Contaminating Surface Waters

The risk of natural gas condensate spills contaminating surface waters would be increased under Alternative B compared to the No Action Alternative. There would be 77 (24%) more pipeline miles (393 miles total under Alternative B and 316 miles total under the No Action Alternative) and 127 (71%) more pipeline stream crossings (600 pipeline stream crossings total under Alternative B and 473 pipeline stream crossings total under the No Action Alternative) of intermittent/ephemeral streams under Alternative B than under the No Action Alternative (see Table 4-134). The closest pipeline stream crossing to the Green River is approximately the same (0.8 and 0.81 mile) between Alternative B and No Action, though the closest pipeline stream crossing to Nine Mile Creek is considerably closer under Alternative B (0.16 mile) than under the No Action Alternative (4.68 miles; see Table 4-135). The closest pipeline stream crossing to Pariette Draw under Alternative B is 13.21 miles, compared to 3.04 miles under No Action. Overall, the risk of a spill of natural gas condensate contaminating surface waters is greater under Alternative B than under the No Action Alternative.

The likelihood of a spill would also be increased under Alternative B compared to the No Action Alternative. Under Alternative B there would be 1.5 miles of pipeline in the Green River floodplain resulting in a risk of 0.046 incidents over the 30-year production phase of the project, or one incident every 657 years. Eleven miles of pipelines crossing floodplains within 5 miles of the Green River would carry a risk of 0.33 incidents over the 30-year production phase of the project, or one incident every 90 years. By comparison, under the No Action Alternative there would be 0.6 mile of pipeline in the Green River floodplain resulting in a risk of 0.018 incidents over the 30-year production phase of the project, or one incident every 1,678 years Within 5 miles of the Green River there would be 7.5 miles of pipelines crossing floodplains resulting in a risk of 0.22 incidents over the 30-year production phase of the project, or one incident every 133 years (see Table 4-136).

The risk of a spill from evaporative facilities would also be greater under Alternative B than under the No Action Alternative. Under Alternative B approximately 135 acres of evaporative facilities would be built in the northeastern portion of the project area. This is nearly 2.5 times more area devoted to evaporative facilities than under the No Action Alternative where 57 acres of evaporative facilities would be built (see Table 4-137).

4.15.1.2.3 Wetlands and Riparian Areas

There would be no direct effects on wetlands and riparian areas under Alternative B because no surface disturbance would occur in these areas (see Table 4-138). Indirect effects would include the contribution of sediment and debris to wetlands and riparian areas as a result of runoff from disturbed uplands. These indirect effects would be increased under Alternative B compared to the No Action Alternative because approximately 3,530 more acres of disturbance (5,528 acres of disturbance under Alternative B compared with 1,998 acres of disturbance under the No Action Alternative) would occur (see Table 4-131). Water and soils in wetlands and riparian areas would also be at risk of contamination by spills of natural gas condensate and spills from evaporative facilities. These risks are discussed above under Spills Potentially Contaminating Surface Waters.

4.15.1.2.4 Floodplains

Direct impacts on floodplains would be increased under Alternative B compared to the No Action Alternative. There would be 89 (more than two times) more acres of disturbance (152 acres of disturbance in floodplains under Alternative B compared to 63 acres under the No Action Alternative) and 21 (nearly three times) more well pads sited in floodplains (32 well pads sited in floodplains under Alternative B compared to 11 well pads under the No Action

Alternative) under Alternative B than under the No Action Alternative (see Table 4-139). Lastly, there would be approximately 43% more miles of roads and pipelines in the 100-year floodplain under Alternative B than under the No Action Alternative (6.3 miles of roads and pipelines under Alternative B, compared to 4.4 miles of roads and pipelines under the No Action Alternative).

4.15.1.3 ALTERNATIVE C: FULL DEVELOPMENT

Under Alternative C the number of wells developed would be 1,887. This is the full development alternative.

4.15.1.3.1 GROUNDWATER RESOURCES

4.15.1.3.1.1 Groundwater Depletion

Under Alternative C drilling, completion and production activities in the project area would result in approximately 25,715 acre-feet of produced groundwater for the 45-year life (30 years of production) of the project (see Table 4-128). This is approximately 5.1 times more than under the No Action Alternative (5,015 acre-feet of produced groundwater over the life of the project). The percentage decrease in water stored in Uinta Basin aquifers under Alternative C would be approximately 0.08%, compared to 0.02% under the No Action Alternative (see Table 4-128).

4.15.1.3.1.2 Groundwater Quality

Under Alternative C, impacts to groundwater quality would be the same as described under the Proposed Action. Potential direct and indirect impacts to usable groundwater sources would be effectively eliminated, reduced or mitigated through the application of required and standard stipulations and lease notices and the below guidance, regulations, Onshore Oil and Gas Orders, and standard COAs.

4.15.1.3.2 SURFACE WATER RESOURCES

4.15.1.3.2.1 Surface Water Use

Under Alternative C surface water withdrawals would be 365 acre-feet over the 45-year life of the project and would reach a peak of 23 acre-feet per year during the initial 15-year drilling and completion phase. This is approximately 294 (or 5.1 times) more acre-feet than under the No Action Alternative. The percentage decrease in Green River flows as a result of surface water withdrawals would be approximately 0.000006% under Alternative C, compared to 0.000001% under the No Action Alternative (see Table 4-129).

4.15.1.3.2.2 Surface Water Quality

Sediment, Turbidity, and Temperature

The nature of water quality impacts associated with sediment, turbidity, and temperature would be similar to those described for the Proposed Action (see Section 4.15.1.1.2.2). Sedimentation and turbidity of surface waters would be increased under Alternative C compared to the No Action Alternative. Under Alternative C there would be 652 more road crossings of intermittent/ephemeral streams (see Table 4-130) and approximately 5.1 times more sediment delivery (136,581 tons under Alternative C compared to 26,636 tons under No Action) to the

Green River as a result of well-pad development (see Table 4-131). Sediment delivery to drainages of Lower Nine Mile Creek, Lower Pariette Draw, Upper Pariette Draw, and Sheep Wash-Green River would be approximately 12 times (22,516 tons of sediment under Alternative C versus 1,882 tons under No Action), 4.5 times (28,453 tons versus 6,229 tons), 5.1 times (15,928 tons versus 3,113 tons), and 4.5 times (69,721 tons versus 15,349 tons) more, respectively, under Alternative C than under the No Action Alternative (see Table 4-132).

Salinity, Selenium, Boron

The nature of water quality impacts associated with salinity, selenium, and boron would be similar to those described for the Proposed Action (see Section 4.15.1.1.2.2). Under Alternative C there would be approximately 682 acres of disturbance in soils with excess salts. This is approximately 5.1 times more disturbance in soils with excess salts than under the No Action Alternative (see Table 4-133). This would result in increased concentrations of salts and selenium in surface waters compared to the No Action Alternative.

Spills Potentially Contaminating Surface Waters

The risk of natural gas condensate spills contaminating surface waters would be increased under Alternative C compared to the No Action Alternative. There would be 545 (nearly three times) more pipeline miles (861 pipelines miles under Alternative C compared to 316 under No Action) and 780 (more than 2.5 times) more pipeline stream crossings (1,253 pipeline stream crossings under Alternative C versus 473 under No Action) of intermittent/ephemeral streams under Alternative C than under the No Action Alternative (see Table 4-134). The closest pipeline stream crossing to the Green River is approximately the same between Alternative C (0.82 mile) and No Action (0.81 mile) though the closest pipeline stream crossing to Nine Mile Creek is considerably closer under Alternative C (0.14 mile) than under No Action (4.68 miles) (see Table 4-135). There are no pipeline stream crossings near washes leading to Pariette Draw under Alternative C and the closest pipeline stream crossing to Pariette Draw under No Action is 3.04 miles away. Overall the risk of a spill of natural gas condensate contaminating surface waters is greater under Alternative C than under the No Action Alternative.

The likelihood of a spill would also be increased under Alternative C compared to the No Action Alternative. Under Alternative C there would be 1.8 miles of pipeline in the Green River floodplain resulting in a risk of 0.055 incidents over the 30-year production phase of the project, or one incident every 543 years. Over 24 miles of pipelines crossing floodplains within 5 miles of the Green River would carry a risk of 0.74 incidents over the 30-year production phase of the project, or one incident every 40 years. By comparison, under the No Action Alternative there would be 0.6 mile of pipeline in the Green River floodplain resulting in a risk of 0.018 incidents over the 30-year production phase of the project, or one incident every 1,678 years Within 5 miles of the Green River there would be 7.5 miles of pipelines crossing floodplains resulting in a risk of 0.22 incidents over the 30-year production phase of the project, or one incident every 133 years (Table 4-136).

The risk of a spill from evaporative facilities would also be greater under Alternative C than under the No Action Alternative. Under Alternative C approximately 271 acres of evaporative facilities would be built in the northeastern portion of the project area. This is nearly 5 times more area devoted to evaporative facilities than under the No Action Alternative where 57 acres of evaporative facilities would be built (see Table 4-137).

4.15.1.3.3 Wetlands and Riparian Areas

Direct impacts on wetlands and riparian areas would be increased under Alternative C compared to the No Action Alternative. There would be 4 acres of disturbance (0.32% of wetland and riparian areas in the project area) in wetlands and riparian areas under Alternative C, whereas no disturbance would occur in wetlands and riparian areas under the No Action Alternative (see Table 4-138). Surface disturbance under Alternative C would consist of 0.5 acre of impact from pipelines, 0.1 acre of impact from pipelines and roads, and 3.1 acres of impact from well pads. Indirect impacts to wetlands and riparian areas would also be increased under Alternative C because approximately 7,713 (nearly 4 times) more acres of disturbance would occur than under the No Action Alternative (see Table 4-131). Water and soils in wetlands and riparian areas would also be at risk of contamination by spills of natural gas condensate and spills from evaporative facilities. These risks are discussed above under Spills Potentially Contaminating Surface Waters.

4.15.1.3.4 Floodplains

Direct impacts on floodplains would be increased under Alternative C compared to No Action. There would be 175 (more than three and a half times) more acres of disturbance (238 acres of disturbance in floodplains under Alternative C compared to 63 acres under the No Action Alternative) and 31 (nearly four times) more well pads sited in floodplains (42 well pads sited in floodplains under Alternative C compared to 11 well pads under the No Action Alternative) under Alternative C than under No Action (see Table 4-139). Lastly, there would be nearly 4 times more miles of roads and pipelines in the 100-year floodplain under Alternative C than under the No Action Alternative (16.2 miles of roads and pipelines under Alternative C, compared to 4.4 miles of roads and pipelines under the No Action Alternative).

4.15.1.4 Alternative D: No Action

Under the No Action Alternative impacts would in all cases occur to a lesser degree than under all other alternatives because the number of wells developed would be reduced to 368.

4.15.1.4.1 Groundwater Resources

4.15.1.4.1.1 Groundwater Depletion

Drilling, completion and production activities in the project area would result in approximately 5,015 acre-feet of produced groundwater for the 45-year life of the project (30 years of production) under the No Action Alternative (see Table 4-128). The percentage decrease in water stored in Uinta Basin aquifers under No Action would be approximately 0.02%.

4.15.1.4.1.2 Groundwater Quality

Under the No Action Alternative, impacts to groundwater quality would be the same as described under the Proposed Action. Potential direct and indirect impacts to usable groundwater sources would be effectively eliminated, reduced, or mitigated through the application of required and standard stipulations and lease notices and the below guidance, regulations, Onshore Oil and Gas Orders, and standard COAs.

4.15.1.4.2 Surface Water Resources

4.15.1.4.2.1 Surface Water Use

Under the No Action Alternative, surface water withdrawals would be 71 acre-feet over the 45-year life of the project and would reach a peak of 5 acre-feet per year during the initial 15-year drilling and completion phase. The percentage decrease in Green River flows as a result of surface water withdrawals would be approximately 0.000001% under the No Action Alternative (see Table 4-129).

4.15.1.4.2.2 Surface Water Quality

Sediment, Turbidity, and Temperature

The nature of water quality impacts associated with sediment, turbidity, and temperature would be similar to those described for the Proposed Action (see Section 4.15.1.1.2.2). Under the No Action Alternative there would be 153 road crossings of intermittent/ephemeral streams (see Table 4-130) and 26,636 tons of sediment delivered to the Green River (a 0.010% increase over background) as a result of well pad development (see Table 4-131). Sediment delivery above background would be 1,882 tons to Lower Nine Mile Creek, 6,229 tons to Lower Pariette Draw, 3,113 tons to Upper Pariette Draw, and 15,349 tons to Sheep Wash–Green River under the No Action Alternative (see Table 4-132).

Salinity, Selenium, Boron

The nature of water quality impacts associated with salinity, selenium, and boron would be similar to those described for the Proposed Action (see Section 4.15.1.1.2.2). Under the No Action Alternative there would be 134 acres of disturbance in soils with excess salts. This represents 6.5% of the total area that would be disturbed under this alternative (see Table 4-133).

Spills Potentially Contaminating Surface Waters

The risk of natural gas condensate spills contaminating surface waters would be relatively low under the No Action Alternative. There would be 316 pipeline miles and 473 pipeline crossings of ephemeral streams under the No Action Alternative (see Table 4-134). The closest pipeline stream crossing to the Green River would be 0.81 mile away, while the closest pipeline stream crossing to Pariette Draw and Nine Mile Creek would be 3.04 and 4.68 miles away, respectively (see Table 4-135).

The likelihood of a spill would be very low under the No Action Alternative. Under the No Action Alternative there would be 0.6 mile of pipeline in the Green River floodplain resulting in a risk of 0.018 incidents over the 30-year production phase of the project, or one incident every 1,678 years Within 5 miles of the Green River there would be 7.5 miles of pipelines crossing floodplains resulting in a risk of 0.22 incidents over the 30-year production phase of the project, or one incident every 133 years (Table 4-136).

The risk of a spill from evaporative facilities would also be very low under the No Action Alternative. Under the No Action Alternative, 57 acres of evaporative facilities would be built (see Table 4-137).

4.15.1.4.3 WETLANDS AND RIPARIAN AREAS

There would be no direct effects on wetlands and riparian areas under the No Action Alternative because no surface disturbance would occur in these areas under this alternative. Indirect effects to wetlands and riparian areas would occur from approximately 1,998 acres of disturbance in upland areas (see Table 4-131). Water and soils in wetlands and riparian areas would also be at risk of contamination by spills of natural gas condensate and spills from evaporative facilities. These risks are discussed above under Spills Potentially Contaminating Surface Waters.

4.15.1.4.4 FLOODPLAINS

Under the No Action Alternative 63 acres of disturbance would occur in floodplain areas, including siting 11 wells (see Table 4-139). There would be approximately 4.4 miles of roads and pipelines under this alternative.

4.15.1.5 ALTERNATIVE E: REDUCED DEVELOPMENT WITH DIRECTIONAL DRILLING

Under Alternative E, the number of wells developed would be 1,114 but the number of well pads would be only 330. As with Alternative B, well-pad locations would be precluded from some sensitive areas.

4.15.1.5.1 GROUNDWATER RESOURCES

4.15.1.5.1.1 Groundwater Depletion

Produced groundwater over the life of the project would be the same under Alternative E as under Alternative B (see Table 4-128).

4.15.1.5.1.2 Groundwater Quality

Under Alternative E, impacts to groundwater quality would be the same as described under the Proposed Action. Potential direct and indirect impacts to usable groundwater sources would be effectively eliminated, reduced or mitigated through the application of required and standard stipulations and lease notices and the below guidance, regulations, Onshore Oil and Gas Orders, and standard COAs.

4.15.1.5.2 SURFACE WATER RESOURCES

4.15.1.5.2.1 Surface Water Use

Impacts from surface water use under Alternative E would be the same as under Alternative B (see Table 4-129).

4.15.1.5.2.2 Surface Water Quality

Sediment, Turbidity, and Temperature

The nature of water quality impacts associated with sediment, turbidity, and temperature would be similar to those described for the Proposed Action (see Section 4.15.1.1.2.2). Sedimentation and turbidity of surface waters would be increased under Alternative E compared to the No Action Alternative. Under Alternative E there would be approximately 24% more road crossings

(190 total road crossings) of intermittent/ephemeral streams (see Table 4-130) and approximately 2% more sediment delivery (27,276 total tons of sediment) to the Green River as a result of well-pad development than under the No Action Alternative (see Table 4-131). Sediment delivery to drainages of Lower Nine Mile Creek, Lower Pariette Draw, Upper Pariette Draw, and Sheep Wash-Green River would be approximately 1.9 times (3,661 total tons under Alternative E), 0.6 times (3,578 total tons under Alternative E), 1.2 times (3,827 total tons under Alternative E), and 1.1 times (16,390 total tons under Alternative E) more, respectively, under Alternative E than under the No Action Alternative (see Table 4-132).

Salinity, Selenium, and Boron

The nature of water quality impacts associated with salinity, selenium, and boron would be similar to those described for the Proposed Action (see Section 4.15.1.1.2.2). Under Alternative E, there would be approximately 107 acres of disturbance in soils with excess salt. This is approximately 20% less disturbance in soils with excess salts than under the No Action Alternative (see Table 4-133). This would result in decreased concentrations of salts and selenium in surface waters compared to the No Action Alternative.

Spills Potentially Contaminating Surface Waters

The risk of natural gas condensate spills contaminating surface waters would be decreased under Alternative E compared to the No Action Alternative. There would be 100 (32%) fewer pipeline miles (216 miles total under Alternative E and 316 miles total under the No Action Alternative) and 126 (27%) fewer pipeline stream crossings (347 pipeline stream crossings total under Alternative E and 473 pipeline stream crossings total under the No Action Alternative) of ephemeral streams under Alternative E than under the No Action Alternative (see Table 4-134). The closest pipeline stream crossing to the Green River is approximately the same (0.8 and 0.81 mile) between Alternative E and the No Action Alternative, although the closest pipeline stream crossing to Nine Mile Creek is closer under Alternative E (2.9 miles) than under No Action (4.68 miles) (see Table 4-135). The closest pipeline stream crossing to Pariette Draw under Alternative E is 12.71 miles, compared to 3.04 miles under No Action. Overall, the risk of a spill of natural gas condensate contaminating surface waters is greater under the No Action Alternative than under Alternative E.

The likelihood of a spill in the Green River floodplain would be decreased under Alternative E compared to the No Action Alternative. Under Alternative E there would be 0.6 mile of pipeline in the Green River floodplain resulting in a risk of 0.017 incidents over the 30-year production phase of the project, or one incident every 1,742 years. By comparison, under the No Action Alternative there would be 0.6 mile of pipeline in the Green River floodplain resulting in a risk of 0.018 incidents over the 30-year production phase of the project, or one incident every 1,678 years. The likelihood of a spill in floodplains within 5 miles of the Green River would be increased under Alternative E compared to the No Action Alternative. Under Alternative E, approximately 10.9 miles of pipelines crossing floodplains within 5 miles of the Green River would carry a risk of 0.33 incidents over the 30-year production phase of the project, or one incident every 92 years. Under the No Action Alternative, within 5 miles of the Green River there would be 7.5 miles of pipelines crossing floodplains resulting in a risk of 0.22 incidents over the 30-year production phase of the project, or one incident every 133 years (see Table 4-136).

The risk of a spill from evaporative facilities would be the same under Alternative E as under Alternative B, because total acres of evaporative facilities (135 acres) would be the same under both alternatives (see Table 4-137).

4.15.1.5.3 Wetlands and Riparian Areas

There would be no direct effects on wetlands and riparian areas under Alternative E because no surface disturbance would occur in these areas (Table 4-138). Indirect effects would include the contribution of sediment and debris to wetlands and riparian areas as a result of runoff from disturbed uplands. These indirect effects would be increased under Alternative E compared to the No Action Alternative because approximately 176 more acres of disturbance (2,174 acres of disturbance under Alternative E compared with 1,998 acres of disturbance under the No Action Alternative) would occur (see Table 4-131). Water and soils in wetlands and riparian areas would also be at risk of contamination by spills of natural gas condensate and spills from evaporative facilities. These risks are discussed above under Spills Potentially Contaminating Surface Waters.

4.15.1.5.4 Floodplains

Direct impacts on floodplains would be similar under Alternative E or under the No Action Alternative. There would be 65 acres of disturbance in floodplains under Alternative E compared to 63 acres under the No Action Alternative. Further, there would be 10 well pads sited in floodplains under Alternative E compared to 11 well pads under the No Action Alternative (see Table 4-139). Miles of roads and pipelines under Alternative E and the No Action Alternative would be 5.6 and 4.4, respectively.

4.15.1.6 Alternative F: Agency Preferred Alternative

Under Alternative F, the number of wells developed would be 1,298, but the number of well pads would be only 575. As with Alternatives B and E, well-pad locations would be precluded from some sensitive areas.

4.15.1.6.1 Groundwater Resources

4.15.1.6.1.1 Groundwater Depletion

Produced groundwater over the life of the project would be 17,688 acre-feet. This is 2,630 acre-feet less than under the Proposed Action but 12,674 acre-feet more than the No Action Alternative and 2,507 acre-feet more than Alternative E, Directional Drilling (see Table 4-128).

4.15.1.6.1.2 Groundwater Quality

Under Alternative F, impacts to groundwater quality would be the same as described under the Proposed Action. Potential direct and indirect impacts to usable groundwater sources would be effectively eliminated, reduced, or mitigated through the application of required and standard stipulations and lease notices and the below guidance, regulations, Onshore Oil and Gas Orders, and standard COAs.

4.15.1.6.2 Surface Water Resources

4.15.1.6.2.1 Surface Water Use

Under Alternative F surface water withdrawals would be 251 acre-feet over the 45-year life of the project and would reach a peak of 23 acre-feet per year during the initial 15-year drilling and completion phase. The percentage decrease in Green River flows as a result of surface water withdrawals would be less than 0.000006% under the Alternative F (see Table 4-129). Surface Water Quality.

Sedimentation and Turbidity

Sedimentation and turbidity of surface waters would be increased under Alternative F compared to the No Action Alternative. Under Alternative F there would be approximately 2.5 times more road crossings (384 total road crossings) of intermittent/ephemeral streams (see Table 4-130) and approximately 2.5 times more sediment delivery (47,817 total tons of sediment) to the Green River as a result of well-pad development than under the No Action Alternative (see Table 4-131). Sediment delivery to drainages of Lower Nine Mile Creek, Lower Pariette Draw, Upper Pariette Draw, and Sheep Wash-Green River would be approximately 3.2 times more (11,981 total tons under Alternative F), 1.6 times less (5,658 total tons under Alternative F), 1.7 times more (6,656 total tons under Alternative F), and 1.4 times more (23,546 total tons under Alternative F), respectively, under Alternative F than under the No Action Alternative (see Table 4-132).

Salinity and Selenium

Under Alternative F, there would be approximately 146 acres of disturbance in soils with excess salt. This is approximately 10% more disturbance in soils with excess salts than under the No Action Alternative (see Table 4-133). This would result in minimal increased concentrations of salts and selenium in surface waters compared to the No Action Alternative.

Spills Potentially Contaminating Surface Waters

The risk of natural gas condensate spills contaminating surface waters would be decreased under Alternative F compared to the No Action Alternative. There would be the same amount of pipeline miles (316 miles total under Alternative F and the No Action Alternative) and 271 (57%) more pipeline stream crossings (744 pipeline stream crossings total under Alternative F and 473 pipeline stream crossings total under the No Action Alternative) of ephemeral streams under Alternative F than under the No Action Alternative (see Table 4-134). The closest pipeline stream crossing to the Green River is approximately 0.3 mile closer under Alternative F than the No Action Alternative (1.1 and 0.81 miles), and the closest pipeline stream crossing to Nine Mile Creek is closer under Alternative F (0.6 mile) than under No Action (4.68 miles) (see Table 4-135). The closest pipeline stream crossing to Pariette Draw under Alternative F is 1.2 miles, compared to 3.04 miles under No Action. Overall, the risk of a spill of natural gas condensate contaminating surface waters is greater under Alternative F than under the No Action Alternative.

The likelihood of a spill in the Green River floodplain would be decreased under Alternative F compared to the No Action Alternative. Under Alternative F there would be no pipeline in the Green River floodplain. By comparison, under the No Action Alternative there would be 0.6 mile of pipeline in the Green River floodplain resulting in a risk of 0.018 incidents over the 30-

year production phase of the project, or one incident every 1,678 years. The likelihood of a spill in floodplains within 5 miles of the Green River would be less under Alternative F compared to the No Action Alternative. Under Alternative F, no pipelines would cross floodplains within 5 miles of the Green River so the risk of incidents over the 30-year production phase of the project would be essentially zero. In comparison, under the No Action Alternative there would be 7.5 miles of pipelines crossing floodplains within 5 miles of the Green River, resulting in a risk of 0.22 incidents over the 30-year production phase of the project, or one incident every 133 years (see Table 4-136).

The risk of a spill from evaporative facilities would be more under Alternative F than under the No Action Alternative, because 21 more acres of evaporative facilities would be built under Alternative F then under the No Action Alternative (78 acres under Alternative F compared to 57 under the No Action Alternative; see Table 4-137).

4.15.1.6.3 Wetlands and Riparian Areas

There would be no direct effects on wetlands and riparian areas under Alternative F because no surface disturbance would occur in these areas (Table 4-138). Indirect effects would include the contribution of sediment and debris to wetlands and riparian areas as a result of runoff from disturbed uplands. These indirect effects would be increased under Alternative F compared to the No Action Alternative because approximately 1,604 more acres of disturbance (3,602 acres of disturbance under Alternative F compared with 1,998 acres of disturbance under the No Action Alternative) would occur (see Table 4-131). Water and soils in wetlands and riparian areas would also be at risk of contamination by spills of natural gas condensate and spills from evaporative facilities. These risks are discussed above under the section Spills Potentially Contaminating Surface Waters.

4.15.1.6.4 Floodplains

Direct impacts on floodplains would be less under Alternative F than under all other alternatives, including the No Action Alternative. There would not be any disturbance in floodplains under Alternative F compared to 63 acres under the No Action Alternative. Further, there would not be any well pads sited in floodplains under Alternative F compared to 11 well pads under the No Action Alternative (see Table 4-139). Miles of roads and pipelines under Alternative F and the No Action Alternative would be 0 and 4.4, respectively.

4.15.2 Mitigation

Because there is some uncertainty associated with impacts to water quality associated with the project, a long-term water monitoring plan (monitoring plan) has been developed as an additional mitigation measure and is contained in Appendix O. The plan would be followed throughout the life of the project and would closely track project impacts on surface and groundwater in the project area. This monitoring plan would also serve as a tool to expeditiously identify potential impacts from the WEF. Monitoring results would be sent to UDOGM, the UDWQ, and the BLM. Any impacts discovered would be immediately addressed by the appropriate agencies (i.e., the BLM, UDWQ, and UDOGM).

In addition, several mitigation measures are proposed below to reduce or avoid impacts to groundwater, surface water, wetlands and riparian areas, and floodplains. These BMP’s are best performed using advanced planning, good scheduling, and routine maintenance. These could include the following:

- As determined appropriate by the AO, Toxic Characteristic Leaching Procedure (TCLP) testing will used to characterize drilling waste as hazardous or non-hazarous, thereby ensuring proper disposal of drilling waste.
- Roads would be designed and constructed to divert stormwater runoff around the pad and reduce erosion by proper design and installation of erosion control structures, such as water bars, diversion channels, and silt fences.
- To the fullest extent possible, road construction on slopes between 40% and 60% would be avoided.
- An erosion control and road maintenance plan for road construction would be developed in cases where road construction cannot be avoided on slopes between 40% and 60%. Engineering drawings of proposed roads would be provided to the AO and would require approval by the AO.
- At sites without clay soils, where soils are moderately to highly permeable, as well as sites closer to ephemeral/perennial channels, the reserve pit (if used) would be lined with a 12- or 16-mil pit liner on top of a protective felt layer to minimize the potential for pit fluid leaks.
- Siting well pads within active drainages would be avoided.
- Siting well pads or roads in wetlands and riparian areas would be avoided.
- A closed system would be required for all well pads placed on terraces adjacent to the active drainage of a designated floodplain, and for all well pads placed adjacent to wetlands and riparian areas.
- To the fullest extent possible, access roads proposed in valley/drainage bottoms would be sited on the toe of the adjacent slope to the valley bottom. Appropriate energy dissipaters (e.g. water bars, silt fences) would be installed where water leaves the road.
- As conditions dictate, diversion ditches would be constructed around well pads. Where diversion ditches are constructed to reroute drainages around well pads, the ditches would be designed to return the diverted water back to the original channel. If it is not feasible to return diverted water back to its original channel, the water would be diverted to the nearest channel, and energy dissipating devices would be installed to prevent channel degradation.
- Surface pipelines that cross stream channels would be elevated above all possible flood flows that may occur on-site. At minimum, pipelines would be elevated above the 100-year flood elevation. As identified by the AO, pipelines would alternatively be buried below the level of scour where they cross stream channels.
- Surface pipelines that cross stream channels will incorporate a sediment retention system along the construction corridor to minimize movement of sediment into the water courses. These could range from silt fencing and culverts to sediment retention basins, depending on the location.

- All produced water disposal facilities would have a secondary containment system to prevent accidental discharges into surface waters.
- All produced water disposal facilities would be sited away from active drainages to prevent surface water inputs or erosion of berms and facilities.
- All tanks at production facilities would be bermed sufficiently to contain the contents of the largest tank or connected series of tanks.
- Pipeline crossings of riparian areas would be avoided to the degree practicable.
- Where pipeline crossings are unavoidable, crossings would be constructed to minimize the area of disturbance and reclamation of disturbed riparian habitat would be implemented as quickly as possible.
- Natural gas pipelines that cross perennial, intermittent, and ephemeral stream channels would have automatic shutoff valves to reduce the magnitude of contamination in the event of an accidental pipeline break.
- Wells with the potential to contaminate surface waters would have automatic shutoff valves.
- Wells proposed within the Green River's 100-year floodplain would be relocated to non-floodplain areas or drilled directionally from beyond the floodplain.
- Road crossings would be built to accommodate the 100-year flood, and at grade crossings would be used for ephemeral and intermitted stream crossings rather than culverts.
- All applicable Fluid Minerals BMPs from Appendix R of the Vernal RMP (BLM 2008c) would be implemented.
- A closed-loop drilling system would be used in areas of porous soils over fractured bedrock when drilling through a DWSPZ or SSA, or in areas of shallow groundwater.
- New surface-disturbing activities within active floodplains, wetlands, public water reserves, or within 330 feet of riparian areas would be avoided, and the construction of new stream crossings would be kept to a minimum unless: 1) there are no practical alternatives; 2) impacts could be fully mitigated; or 3) the action is designed to enhance the riparian resources.
- A buffer strip of vegetation would be maintained between areas of surface disturbance and riparian vegetation.
- In the case of encountering an isolated or ephemeral wetland during project construction, surface disturbance and diversions of surface water would be avoided or minimized, pumping of groundwater in or adjacent to ephemeral or isolated wetlands would be avoided or minimized, and silt fencing or other measures would be installed to protect the site from erosion or contamination.
- If vegetation surrounding the well pad does not provide at least 60% ground cover within 60 days of creating the well pad, engineering practices would be implemented to control erosion. Such engineering measures may include mulching, use of fiber mats, cross-slope trenching, contour furrows, rock dams, terracing, or other erosion control practices.
- Vegetation and/or structural measures to control erosion would be implemented as soon as possible after initial soil disturbance to prevent erosion of disturbed soils.

Additional recommended mitigation measures, including those identified in the Pariette Draw TMDL, to avoid and minimize adverse impacts to water resources are

- reserve pits would not be constructed in areas of shallow groundwater and natural watercourses;
- wells would not be developed on steep slopes (including but not limited to no surface occupancy slopes), saline facies, stream corridors, formerly irrigated lands, or highly erodible soils;
- reclaim pits and well sites back to natural condition by revegetating with biologically active top-soil;
- design and construct culverts to allow passage of aquatic species;
- install energy dissipation devices; and
- immediately stabilize cut side slopes.

4.15.3 Unavoidable Adverse Impacts

Unavoidable adverse impacts from the Proposed Action and alternatives include long-term decreases in available groundwater and surface water resources due to consumptive use. In surface waters, increased sediment would occur due to on-going project activities that result in surface disturbance (whether initial or ongoing).

4.15.4 Irretrievable and Irreversible Commitments of Resources

Under the Proposed Action and alternatives, irretrievable commitments of resources would be limited to loss of riparian vegetation and decreased PFC and loss or alteration of floodplain function during the project lifetime. The functional value of these resources would be irretrievably lost until restoration is completed. Irreversible impacts would be limited to the transfer of water from aquifers underlying the project area and transfer of water from the Green River due to upstream withdrawals from Babcock Draw. These water withdrawals and transfers represent impacts that cannot be restored. All other impacts to water resources, wetlands and riparian areas, and floodplains would be neither irretrievable nor irreversible.

4.15.5 Relationship of Short-term Uses to Long-term Productivity

Construction of roads, pipelines, wells, and associated facilities would provide a short-term mineral use resulting in long-term impacts to groundwater and surface water quantities available in the area. Long-term impacts to groundwater and surface water quantities are due to the consumptive use of these resources for well drilling, completion, and production. Other impacts to water resources as a result of short-term mineral use would be limited to the life of the project.

4.16 Wildlife

This section analyzes impacts to big game, small game, and other wildlife species. To determine the impacts of different alternatives to the wildlife resources and their associated habitats, project components were examined relative to the temporal and spatial patterns of both resident and migratory wildlife species and the current wildlife population trends apparent in the project area. BLM habitat designations and mapping, in addition to UDWR habitat descriptions and mapping, were used for analyses pertaining to big game. Southwest Regional Gap Analysis Project (SWReGAP) vegetation data were used to map habitat for all other wildlife species. The following criteria (WGFD 2004) were used to assess impacts to terrestrial wildlife resources due to natural gas development:

- Direct loss or degradation of native habitat and displacement of wildlife species from habitat due to development assessed as acres of surface disturbance within each habitat type
- Indirect increases in the potential for poaching or harassment of wildlife assessed as a relative risk of poaching and harassment due to relative level of access provided from project-related roads and increased traffic
- Increased risk of wildlife mortality assessed as relative risk of mortality due to relative level of access and increased traffic
- Fragmentation and isolation of connected habitats assessed by habitat fragmentation analysis described in Section 4.16.1.1.7.2, Effects of Habitat Fragmentation on Wildlife

These potential impacts are addressed in general for all wildlife, with more detailed analyses where possible. The severity of both short- and long-term impacts upon a given species would depend on factors such as the sensitivity of the species; its seasonal use patterns; the type and timing of project activities; and physical parameters such as topography, forage availability, and climate. For the purposes of this analysis, short-term impacts would be associated with the construction phase of the project, while long-term impacts pertain to the operation and maintenance phase, and the subsequent reclamation and revegetation activities.

The general effects of increased traffic as described above would be the same for all species examined. (Estimated increases in traffic and other transportation-related impacts are described in detail in Section 4.5, Land Use and Transportation, and are only briefly reiterated below.) Estimated maximum traffic increases (described in Section 4.16.1.1.1, Table 4-145, and in analyses for big game) are for Highway 40 near Myton, Utah, not for the project area. Maximum increases in traffic volume for roads in the project area are likely to be higher, but no data exist for traffic on these roads. However, in general, traffic increases would be a result of more wells and roads being created, so traffic increases would correspond to surface disturbance from wells and roads, and are therefore assumed worse in cases with higher disturbance.

4.16.1 Direct and Indirect Effects

Direct and indirect effects on wildlife resources would be similar under all alternatives. Impacts would vary in degree based on the number of wells and associated roads, pipelines, and other facilities proposed. Potential impacts are described in greater detail under Alternative A (Proposed Action), below, than under Alternatives B–F. Potential impacts associated with the Proposed Action and Alternatives B, C, E, and F are compared with the No Action Alternative.

4.16.1.1 Alternative A: Proposed Action

Under the Proposed Action, 1,491 new natural gas wells would be drilled. Well-drilling activities would require approximately 325 miles of new roads, 431 miles of new pipeline, and 143 acres of evaporative facilities for produced groundwater. Total acres of disturbance under the Proposed Action would be approximately 7,584 (Table 4-140). Four times more wells would be drilled under the Proposed Action than under the No Action Alternative. Approximately 4.5 times more new roads would be constructed along with 1.4 times more miles of new pipelines. Total acres of evaporative facilities and total acres of surface disturbance under the Proposed Action would be approximately 3.8 times the disturbance level under the No Action Alternative (see Table 4-140).

Table 4-140. New Natural Gas Wells, Miles of New Roads, Miles of New Pipeline, Acres of Evaporative Facilities, and Total Acres of Surface Disturbance by Alternative[1]

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Number of new natural gas wells	1,491	1,114	1,887	368	1,114	1,298
Miles of new roads	325	274	526	72	106	198
Miles of new pipeline	431	393	861	316	216	316
Acres of evaporative facilities	143	135	271	57	135	78
Total acres of surface disturbance	7,584	5,685	9,982	2,055	2,175	3,602

[1]This information is also displayed in Table 2-6 (Section 2.8, Comparison of Alternatives).

4.16.1.1.1 Big Game

Direct and indirect impacts to big game under the Proposed Action would be similar for each big-game species (mule deer, elk, pronghorn antelope, and Rocky Mountain bighorn sheep). Direct adverse impacts would occur as a result of land conversion from big-game habitat to well pads, roads, and evaporative facilities. The total acres of BLM-designated big-game habitat lost due to project implementation are shown in Table 4-141. The total acres of UDWR big-game habitat lost due to project implementation are shown in Table 4-142. Habitat fragmentation, discussed in detail below (see Section 4.16.1.1.7) for mule deer, elk, and bighorn sheep, would be another direct adverse long-term impact.

Road-collision fatalities, potential increased hunter success (both legal and illegal hunting), and increased risk of harassment of big-game species are indirect adverse impacts that would occur as a result of increased access and project- and non-project-related traffic on project area roads located in big-game habitat. These potential indirect adverse impacts were assessed through estimated maximum increases in traffic in the project area (see Table 4-145) and total linear miles of proposed new roads in BLM-designated and UDWR habitat (Table 4-143 and Table 4-144).

Table 4-141. Acres of Disturbance (and Percentage of Total Designated Habitat in the Project Area Disturbed) in BLM-designated Habitat for Mule Deer, Elk, Pronghorn Antelope, and Rocky Mountain Bighorn Sheep by Alternative

Species	Habitat	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Mule Deer	Crucial Winter	0 (0%)	0 (0%)	10 (8%)	0 (0%)	0 (0%)	0 (0%)
	High-priority Winter	2,043 (3%)	1,720 (3%)	3,048 (5%)	382 (1%)	664 (1%)	1323 (2%)
	Substantial winter	1,789 (6%)	1,449 (5%)	1,605 (5%)	296 (1%)	481 (2%	789 (3%)
	Crucial year-long	120 (2%)	79 (1%)	109 (1%)	32 (≤1%)	28 (≤1%)	1 (≤1%)
	Limited year-long	3,630 (4%)	2,437 (2%)	5,205 (5%)	1,344 (1%)	1,000 (1%)	1488 (1%)
	Total	7,582 (4%)	5,685 (3%)	9,977 (5%)	2,054 (1%)	2,173 (1%)	3,600 (2%)
Elk	Crucial Winter	1,321 (3%)	1,317 (3%)	2,546 (5%)	413 (1%)	519 (1%)	882 (2%)
	High-priority winter	1,112 (4%)	574 (2%)	1,147 (4%)	109 (≤1%)	203 (≤1%)	666 (2%)
	Limited winter	3,126 (4%)	2,373 (3%)	4,585 (6%)	1,284 (2%)	975 (1%)	1,219 (2%)
	Substantial winter	2,026 (5%)	1,421 (3%)	1,701 (4%)	249 (1%)	477 (1%)	833 (2%)
	Total	7,584 (4%)	5,685 (3%)	9,979 (5%)	2,055 (1%)	2,174 (1%)	3,600 (2%)
Pronghorn Antelope	Crucial year-long	4,944 (4%)	3,641 (3%)	5,786 (5%)	1,488 (1%)	1,396 (1%)	1,911 (2%)
	High-priority Year-long	1,688 (3%)	1,198 (2%)	2,563 (5%)	318 (1%)	459 (≤1%)	1,083 (2%)
	Limited year-long	948 (3%)	842 (2%)	1,576 (4%)	249 (1%)	319 (≤1%)	607 (2%)
	Total	7,580 (4%)	5,681 (3%)	9,925 (5%)	2,055 (1%)	2,174 (1%)	3,600 (2%)

Table 4-141. Acres of Disturbance (and Percentage of Total Designated Habitat in the Project Area Disturbed) in BLM-designated Habitat for Mule Deer, Elk, Pronghorn Antelope, and Rocky Mountain Bighorn Sheep by Alternative

Species	Habitat	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Rocky Mountain Bighorn Sheep	Potential Year-long	3,050 (4%)	1,780 (2%)	3,194 (4%)	356 (≤1%)	667 (≤1%)	1,703 (2%)
	Total	3,050 (4%)	1,780 (2%)	3,194 (4%)	356 (≤1%)	667 (≤1%)	1,703 (2%)

Table 4-142. Acres of Disturbance (and Percentage of Total Habitat Disturbed in the Project Area) in UDWR Habitat for Mule Deer, Elk, Pronghorn Antelope, and Rocky Mountain Bighorn Sheep by Alternative

Species	Habitat	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Mule Deer	Crucial Spring/Fall	0 (0%)	0 (0%)	6 (3%)	0 (0%)	0 (0%)	0 (0%)
	Crucial Winter	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
	Crucial Year-long	220 (2%)	160 (1%)	306 (2%)	93 (1%)	58 (0.4%)	50 (0%)
	Substantial Winter	2,004 (3%)	1,423 (2%)	2,856 (4%)	383 (1%)	539 (1%)	1,305 (2%)
	Substantial Year-long	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
	Total	2,224 (3%)	1,583 (2%)	3,168 (4%)	476 (1%)	597 (1%)	1,355 (2%)

Table 4-142. Acres of Disturbance (and Percentage of Total Habitat Disturbed in the Project Area) in UDWR Habitat for Mule Deer, Elk, Pronghorn Antelope, and Rocky Mountain Bighorn Sheep by Alternative

Species	Habitat	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Elk	Crucial Summer	3 (9%)	3 (9%)	2 (6%)	0 (0%)	0 (0%)	0 (0%)
	Crucial Winter	8 (9%)	5 (5%)	5 (5%)	4 (4%)	2 (2%)	4 (0%)
	Crucial Year-long	1,112 (2%)	1,101 (2%)	2,355 (5%)	429 (1%)	449 (1%)	714 (1%)
	Substantial Winter	158 (2%)	148 (1%)	314 (3%)	18 (0.2%)	74 (0%)	81 (0%)
	Substantial Year-long	1,617 (3%)	1,035 (2%)	2,185 (4%)	224 (0.4%)	426 (1%)	1,047 (1%)
	Total	2,911 (3%)	2,292 (2%)	4,861 (4%)	675 (1%)	951 (1%)	1,846 (2%)
Pronghorn Antelope	Crucial Year-long	4,566 (5%)	3,353 (3%)	5,411 (6%)	1,385 (1%)	1,286 (1%)	1,784 (2%)
	Substantial Year-long	162 (2%)	160 (2%)	464 (6%)	87 (1%)	60 (1%)	118 (0%)
	Total	4,728 (5%)	3,513 (3%)	5,875 (6%)	1,472 (1%)	1,346 (1%)	1,901 (2%)
Rocky Mountain Bighorn Sheep	Crucial Year-long	303 (2%)	216 (2%)	554 (4%)	118 (1%)	61 (0.4%)	68 (1%)
	Substantial Year-long	867 (4%)	472 (2%)	1,016 (4%)	98 (0.4%)	181 (1%)	503 (1%)
	Total	1,170 (3%)	688 (2%)	1,570 (4%)	216 (1%)	242 (1%)	571 (1%)

Table 4-143. Miles of New Roads in BLM-designated Habitat in the Project Area for Mule Deer, Elk, Pronghorn Antelope, and Rocky Mountain Bighorn Sheep by Alternative

Species	Habitat	Existing Roads	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Mule Deer	Crucial winter	4	0	0	0	0	0	0
	High-priority winter	151	101	95	178	15	39	81
	Substantial winter	98	87	74	98	10	25	46
	Crucial year-long	27	4	4	8	1	1	0
	Limited year-long	279	133	100	253	45	41	70
	Total	559	325	273	537	71	106	197
Elk	Crucial winter	135	63	68	141	14	32	52
	High-priority winter	58	57	36	79	7	10	41
	Limited winter	256	104	97	210	42	39	54
	Substantial winter	110	101	74	106	10	25	50
	Total	559	325	275	536	73	106	197
Pronghorn Antelope	Crucial year-long	338	194	161	277	50	61	96
	High-priority year-long	116	88	69	159	13	27	65
	Limited year-long	99	43	43	99	9	18	36
	Total	553	325	273	535	72	106	197
Rocky Mountain Bighorn Sheep	Potential year-long	169	162	101	219	17	36	101
	Total	169	162	101	219	17	36	101

Table 4-144. Miles of New Roads in UDWR-designated Habitat in the Project Area for Mule Deer, Elk, Pronghorn Antelope, and Rocky Mountain Bighorn Sheep by Alternative

Species	Habitat	Existing Roads	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Mule Deer	Crucial spring/fall	4	0	0	0	0	0	0
	Crucial winter	0	0	0	0	0	0	0
	Crucial year-long	26	9	8	18	3	3	1
	Substantial winter	160	102	82	185	16	30	79
	Substantial year-long	0	0	0	0	0	0	0
	Total	190	111	90	203	19	33	80
Elk	Crucial summer	0	0	0	0	0	0	0
	Crucial winter	0	0	0	0	0	0	0
	Crucial year-long	134	52	55	125	14	25	42
	Substantial winter	12	10	10	23	1	4	4
	Substantial year-long	110	87	66	154	12	23	66
	Total	256	149	131	302	27	52	112
Pronghorn Antelope	Crucial year-long	318	176	145	256	45	55	89
	Substantial year-long	26	8	8	29	3	4	6
	Total	344	184	153	285	48	59	95
Rocky Mountain Bighorn Sheep	Crucial year-long	30	8	8	26	3	2	2
	Substantial year-long	52	45	28	78	5	9	32
	Total	82	53	36	104	8	11	34

Table 4-145. Estimated Maximum % Increase over Current Traffic Volume by Alternative

	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Maximum increase over current traffic volume (%)[1]	4.9%	4.8%	6.2%	1.2%	4.8%	4.5%

[1]Assumes that all project-related traffic would travel on U.S. Highway 40 near Myton, Utah, and is based on this road segment's average 2006 daily traffic volume.

4.16.1.1.1.1 Mule Deer

The primary direct impact to mule deer from natural gas development would be the immediate loss of habitat for forage and cover. The Proposed Action would remove approximately 7,582 acres (4%) of BLM-designated mule deer habitat in the project area during construction of well pads, new roads, and evaporative facilities (see Table 4-141). This is approximately 3.7 times the habitat loss than under the No Action Alternative, where approximately 2,054 acres (1%) of surface disturbance would occur in BLM-designated mule deer habitat. In UDWR mule deer habitat, the Proposed Action would remove approximately 2,224 acres (3% of the total UDWR mule deer habitat in the project area) during construction of well pads, new roads, and evaporative facilities (see Table 4-142). This is approximately 4.7 times the habitat loss than under the No Action Alternative, where approximately 476 acres (0.6%) of surface disturbance would occur in UDWR mule deer habitat. The forage production within this impacted area would be lost for the life of the project, and would therefore constitute a long-term impact. Loss of habitat would result in the displacement of mule deer from disturbed areas to surrounding, less-disturbed areas. Depending on the carrying capacity of the habitats and the number of animals involved, displacement could result in overcrowding of habitats into which the animals are displaced. This overcrowding may cause an increase in competition for space and forage, an increase in the animals' stress levels, and a decrease in the animals' physical conditions. Winter mortality may also increase, and successful reproduction may decrease, resulting in long-term reductions in animal populations (Sawyer et al. 2006). Displacement is of greatest concern in areas that have been recognized as crucial habitat—areas essential for the maintenance of local populations.

Under the Proposed Action, a loss of mule deer habitat value would also result from project activities. Construction and operation of project roads and facilities (including evaporative ponds, which would require the use of generators to operate properly) would result in increased noise and human presence around well pads, roads, pipelines, and evaporative facilities. Mule deer are known to avoid areas where noise and human presence are elevated compared to surrounding areas and previous points in time. To mitigate these impacts, the BLM employs seasonal timing stipulations for drilling and new construction in mule deer crucial winter habitat; no surface disturbance is allowed between December 1 and April 30 (BLM 1994). These stipulations ensure that there are fewer disturbances from construction and drilling during critical winter months, and fewer disturbances from traffic. However, gas-production activities would still result in decreased habitat value for mule deer year-round, as vehicular use related to operation and maintenance would occur throughout the year.

Mule deer in the vicinity of the project area tend to make short and diffuse seasonal migrations along topographical and elevational gradients and do not use migration "corridors" as in other parts of the western united states. Because of this, impacts on mule deer migration and movement patterns largely derive from the habitat fragmentation that would occur from implementation of the Proposed Action. This fragmentation could disrupt normal seasonal movements because mule deer and other big game species tend to avoid habitat with a high concentration of human noise and activity (Sawyer et al. 2006). Where roads and well pads are constructed in seasonal movement areas, mule deer may be forced to use less efficient travel routes to get to summer and winter habitats, therefore using up important energy stores during the spring and fall. Adverse effects of habitat fragmentation are further analyzed in Section 4.16.1.1.7.

Though effects to wildlife during the production phase of oil and gas development are generally considered less impacting than those during the construction and drilling phase, this may not be the case (WGFD 2004). Long-term displacement of wildlife from preferred habitats and migration routes has the potential to affect or even eliminate "migration memory" within entire cohorts of young animals (WGFD 2004). The degree of mule deer displacement and reduction in habitat value would vary depending on the habitat types, vegetative cover, topography, existing herd size, winter snow conditions, animal health, traffic levels, and amount of noise and human presence.

Another direct adverse impact of the Proposed Action on mule deer would be vehicle-related deer mortalities resulting from an increase in roads and vehicular traffic (project and non-project related). Most project-related traffic along well access roads would occur during the daytime and at or below project speed limits. Also, much of the project area is composed of relatively flat, open terrain. Given these conditions, alert drivers would be able to avoid hitting most deer near the roads. Non-project-related traffic, however, may be traveling fast or at night, and may be more likely to collide with deer. An increase in the number of miles of roads would likely lead to an increase in deer fatalities along those roads. An expanded road network would also allow increased access for hunters and other individuals. Increased access for these individuals would likely result in greater hunter success (for legal and illegal hunting), and therefore greater deer mortality. Increased access would also translate into a greater degree of harassment and noise disturbance of mule deer. There are currently approximately 559 miles of roads in BLM-designated mule deer habitat in the project area. Under the Proposed Action, 325 miles of new roads would be built in BLM-designated mule deer habitat (a 58% increase over current conditions), compared to 71 miles of new roads in BLM-designated mule deer habitat (a 13% increase over current conditions) under the No Action Alternative (see Table 4-143). In the project area's UDWR mule deer habitat, there are currently approximately 190 miles of roads. Under the Proposed Action, 111 miles of new roads would be built in UDWR mule deer habitat (a 58% increase over current conditions), compared to 19 miles of new roads in UDWR mule deer habitat (a 10% increase over current conditions) under the No Action Alternative (see Table 4-144). Under the Proposed Action, traffic volume in the project area is estimated to increase by a maximum of 4.9% compared to a maximum increase in traffic volume in the project area of 1.2% under the No Action Alternative (see Table 4-145). Increases in traffic volume are the same for all species and are not repeated in the sections that follow. (See Section 4.5 for additional detail on traffic volume.)

4.16.1.1.1.2 Elk

The primary direct impact to elk would be immediate loss of habitat for forage and cover. The Proposed Action would remove approximately 7,584 acres (4%) of BLM-designated elk habitat in the project area during construction of well pads, new roads, and evaporative facilities (see Table 4-141). This is approximately 3.7 times the amount of surface disturbance under the No Action Alternative, where 2,055 acres (1%) of surface disturbance would occur in BLM-designated elk habitat. In UDWR elk habitat, the Proposed Action would impact approximately 2,911 acres (3% of the total UDWR elk habitat in the project area) during construction of well pads, new roads, and evaporative facilities (see Table 4-142). This is more than 4.3 times the habitat loss as that under the No Action Alternative, where approximately 675 acres (0.6%) of surface disturbance would occur in UDWR elk habitat. The forage production within this impacted area would be lost for the life of the project, and would therefore constitute a long-term impact.

Impacts related to displacement and loss of habitat value would be the same for elk as for mule deer. Accordingly, seasonal timing stipulations employed by BLM to minimize these impacts are the same for mule deer and elk.

The local elk population summers west of the project area, in the aspen stands of Anthro Mountain. It makes an easterly migration into and near the project area for the winter. The best winter habitat in the project area is in the northwestern corner, encompassing Wells Draw. Adverse impacts could occur in this northwestern corner if the well pad and road layout is such that elk movement patterns into the wintering grounds of the project area must be lengthened or otherwise changed in order to reach high quality wintering habitat. Due to the spacing of the proposed wells, it is unlikely that movement into this area would be completely blocked. Adverse effects of habitat fragmentation are further analyzed in Section 4.16.1.1.7, Effects of Habitat Fragmentation on Wildlife, of this document.

Under the Proposed Action, the direct adverse effects of vehicular fatalities and increased traffic would be of the same nature as those described for mule deer, above. There are currently approximately 559 miles of roads in BLM-designated elk habitat in the project area. Under the Proposed Action, 325 miles of new roads would be built in BLM-designated elk habitat (a 58% increase over current conditions), compared to 73 miles of new roads in BLM-designated elk habitat (a 13% increase over current conditions) under the No Action Alternative (see Table 4-143). In UDWR elk habitat, there are currently approximately 256 miles of roads. Under the Proposed Action, 149 miles of new roads would be built there (a 42% increase over current conditions), compared to 27 miles of new roads in UDWR elk habitat (an 11% increase over current conditions) under the No Action Alternative (see Table 4-144).

4.16.1.1.1.3 Pronghorn Antelope

Under the Proposed Action, construction of well pads, roads, and evaporative facilities would directly impact 7,580 acres (see Table 4-141) of BLM-designated pronghorn antelope habitat (4% of habitat available in the project area). This is more than 3.5 times the surface disturbance than under the No Action Alternative, where 2,174 acres of BLM-designated pronghorn antelope habitat would be disturbed (1% of habitat available in the project area). In UDWR pronghorn antelope habitat, the Proposed Action would disturb approximately 4,728 acres (5% of the total UDWR pronghorn antelope habitat in the project area) during construction of well pads, new roads, and evaporative facilities (see Table 4-142). This is more than 3 times the habitat loss than under the No Action Alternative, where approximately 1,472 acres (1.4%) of surface disturbance would occur in pronghorn antelope habitat. No fawning habitat has been identified by the BLM or the UDWR pronghorn antelope habitat in the project area, so there would be no direct impacts to pronghorn fawning activities. No timing stipulations are in place for any pronghorn habitats other than fawning grounds. Impacts related to displacement and loss of habitat value would be the same for pronghorn antelope as for deer and elk. Impacts related to the disruption of migration pattern would be identical to those described for mule deer.

The proposed road network would make the area more accessible to both legal and illegal hunting, and to both deliberate and unintentional harassment. Increased risk of vehicle collisions would also occur due to increased traffic (Table 4-145). There are currently 553 miles of roads in BLM-designated pronghorn antelope habitat in the project area. Under the Proposed Action, there would be 325 miles of new roads (a 58% increase over current conditions) in BLM-designated pronghorn antelope habitat, compared to 72 miles of new roads (a 13% increase over current conditions) under the No Action Alternative (see Table 4-143). In UDWR pronghorn antelope habitat in the project area, there are currently approximately 344 miles of roads. Under the Proposed Action, 184 miles of new roads would be added (a 53% increase over current conditions), compared to 48 miles of new roads in UDWR pronghorn antelope habitat (a 14% increase over current conditions) under the No Action Alternative (see Table 4-144).

4.16.1.1.1.4 Rocky Mountain Bighorn Sheep

General impacts related to displacement and loss of habitat value would be the same for Rocky Mountain bighorn sheep as for the other big-game species. The BLM has identified 81,123 acres of potential year-long habitat for Rocky Mountain bighorn sheep in the southern half of the project area. Under the Proposed Action, 3,050 acres (4%) of this habitat would be disrupted by well pads and new roads (see Table 4-141). This represents 9 times more surface disturbance than would be caused by the No Action Alternative (356 acres, or 0.44% of BLM-designated bighorn sheep habitat in the project area). In UDWR bighorn sheep habitat, the Proposed Action would impact approximately 1,170 acres (3% of the total UDWR bighorn sheep habitat in the project area) during construction of well pads and new roads (see Table 4-142). This is more than 6 times the habitat loss than under the No Action Alternative, where approximately 216 acres (0.6%) of surface disturbance would occur in UDWR bighorn sheep habitat.

Impacts related to vehicle collisions, legal and illegal hunting, and harassment and disturbance of individual animals would be the same for Rocky Mountain bighorn sheep as for the other big-game species. However, given the small number of bighorn sheep in the region, the likelihood of collisions and of adverse effects from increased access would be much lower than for the other large ungulates in the project area. There are currently 169 miles of roads in BLM-designated bighorn sheep habitat in the project area. Under the Proposed Action, there would be 162 miles of new roads (a 96% increase over current conditions) compared to 17 miles of new roads (a 10% increase over current conditions) in BLM-designated bighorn sheep habitat under the No Action Alternative (see Table 4-143). In the project area's UDWR bighorn sheep habitat, there are currently approximately 82 miles of roads. Under the Proposed Action, 53 miles of new roads would be built (a 65% increase over current conditions), compared to 8 miles of new roads in UDWR bighorn sheep habitat (a 10% increase over current conditions) under the No Action Alternative (see Table 4-144).

4.16.1.1.2 MOUNTAIN LION (COUGAR)

Under the Proposed Action, impacts to mountain lions would include direct habitat conversion to well pads, roads, and evaporative facilities; a reduction in prey availability (as prey such as mule deer move away from roads and other development and into lower-value habitats with lower carrying capacities); and a possible increase in harassment as human development encroaches on mountain lion habitat and encounters between humans and lions increase.

This analysis assumes that the local mountain lion population is closely associated with the migratory mule deer herd. It also assumes that the lion population is currently stable. Because of the association between mountain lions and mule deer, changes to the deer herd would result in corresponding changes to the mountain lion population. Deer displacement from preferred habitats may improve short-term lion predation success on mule deer due to increased deer densities and increased stress levels of the deer as they move into more unfamiliar territory. However, deer populations would potentially decrease over time as deer are directly and indirectly influenced by habitat removal (with conversion to gas extraction infrastructure) and habitat value reduction (in buffers around roads and well pads). This, in turn, could lead to a subsequent long-term decrease in the lion population.

Assuming lions use the same preferred habitats as mule deer, lions would experience the direct loss of approximately 7,582 acres (4%) of BLM-designated habitat to well pads, roads, and evaporative facilities under the Proposed Action (see Table 4-141). As with mule deer, this is approximately 3.7 times the habitat loss as under the No Action Alternative, where 2,054 acres (1%) of BLM-designated habitat in the project area would be removed. In UDWR habitat, the Proposed Action would remove approximately 2,224 acres (3% of the project area's total UDWR habitat) during construction of well pads, new roads, and evaporative facilities (see Table 4-143). This is more than 4.6 times the habitat loss as that under the No Action Alternative, where approximately 476 acres (0.6%) of surface disturbance would occur in UDWR habitat. Though lions would follow their prey to new habitats, the loss of this land would constitute a loss of cover for resting and camouflage, and would increase densities of lions in less-preferred habitats. This increased density (as with big-game species) would likely lead to increased stress levels, decreased health, and a long-term decrease in reproductive success in the local lion population.

The effects of an expanded road network would be the same for mountain lions as for mule deer, because they are assumed to share the same habitat. However, the potential for individual fatalities of mountain lions due to vehicular collisions would increase only slightly with a greater number of roads, because mountain lion road kills are currently infrequent in the project area.

4.16.1.1.3 UPLAND GAME

Under the Proposed Action, impacts to upland game would include loss of habitat (7,584 acres, or 4%, of the 206,826 acres of existing habitat in the project area) and potentially increased hunting pressure due to the expanded road network (325 miles, or a 58% increase over current conditions) (see Table 4-140). Loss of habitat would be approximately 3.7 times greater under the Proposed Action than under the No Action Alternative, where 2,055 acres (1%) of habitat would be lost (see Table 4-140). Mourning doves and chukars would be impacted directly by habitat loss and construction-related mortality if construction activities occur during the nesting season.

There are currently 560 miles of roads in the project area allowing access for hunting upland game. The expanded road network would be more than 5 times greater under the Proposed Action (325 miles of new roads, a 58% increase over current conditions) than under the No Action Alternative (72 miles of new roads, a 13% increase over current conditions) (see Table 4-140).

Impacts to greater sage-grouse are discussed in Section 4.12, Special Status Species.

4.16.1.1.4 Reptiles, Amphibians, and Other Non-game Species

Under the Proposed Action, impacts to reptiles and other non-game species would be the same as impacts to upland game (see Section 4.16.1.1.3). Most of these animals have relatively small home ranges, so their populations would not be fragmented by the construction of a network of new roads as effectively as populations of large mammals. In addition, many of these animals have relatively high reproductive rates, and any losses from construction fatalities would quickly be replaced. The removal of shrub-dominated habitat for natural gas infrastructure would potentially make some small mammals, such as jackrabbits and ground squirrels, more susceptible to predation by raptors. Overall, small mammal species would experience minimal long-term reduction in numbers.

Amphibians would be impacted during construction and operation under the Proposed Action because they rely heavily on wetlands/riparian areas and open-water habitats, particularly those with cattails and other aquatic vegetation. Approximately 11 acres of riparian area would be impacted under the Proposed Action. Under the No Action Alternative, no direct impacts to wetlands/riparian areas would occur. Applicant-committed measures to control sedimentation would minimize potential indirect water-quality impacts under any alternative that could adversely impact amphibians. (See Section 4.15, Water Resources, for a discussion of direct and indirect effects on water resources.)

4.16.1.1.5 Aquatic Species

Natural gas development in the project area could result in impacts to aquatic species in perennial waterways (the Green River, Pariette Draw, and Nine Mile Creek) in and near the project area. Ephemeral/intermittent waterways are not discussed because they generally do not provide habitat for aquatic species. Potential impacts to aquatic species in perennial waterways could result from increases in sedimentation, turbidity, and salinity and selenium concentrations. Spills of natural-gas condensate and surface-water depletions of the Green River are other potential adverse effects.

Sedimentation and turbidity could adversely impact aquatic species by filling inter-gravel spaces and pool habitats, thereby reducing available aquatic habitat, including spawning habitat, rearing habitat, and macroinvertebrate production (a fishery's primary food supply; BLM 1999b). Salinity and selenium concentrations that exceed the tolerance thresholds of aquatic species can result in mortality of species, and inhibition of growth, reproduction, and migration (Novotny and Olem 1994). Natural-gas condensate (as described in Section 4.15, Water Resources) is toxic to aquatic life in concentrations exceeding 7.4 milligrams per liter (mg/L). A spill of natural-gas condensate resulting in concentrations greater than 7.4 mg/L in the Green River would result in localized (in the vicinity of the spill) mortality of fish and other aquatic life (BLM 2005b). Finally, depletions of surface water in the Green River could lead to habitat loss and degradation for aquatic species (BLM 2006a).

Impacts to aquatic species would be the same under all alternatives, but would vary in magnitude between alternatives. (All potential impacts to aquatic species, as described above, are discussed in detail for each alternative in Section 4.15, Water Resources, and are therefore not addressed again in this section.)

A discussion of potential impacts to special status aquatic species from the Proposed Action is in Section 4.12, Special Status Species.

4.16.1.1.6 Effects of Evaporative Facilities on Wildlife

Evaporative facilities for produced groundwater can pose a unique risk to wildlife in the absence of mitigation measures such as removal of oil from the water's surface, or properly installed wildlife deterrents. Evaporative facilities, which contain high levels of salts, resemble available water sources and are therefore attractive to wildlife (USFWS 2000; USFWS 2007b). Wildlife can become trapped in mud and drown, or easily become prey to predatory species, ingest toxic quantities of salts by drinking directly from evaporative ponds, or ingesting while cleaning themselves (USFWS 2000; USFWS 2007b). Gas production chemicals, such as corrosion inhibitors and surfactants, can also be found in produced water in evaporative facilities, and can pose similar threats (USFWS 2007b).

All evaporative facilities, regardless of alternative, would be constructed and operated to meet all stipulations outlined in BLM Onshore Order Number Seven. These stipulations include the construction of fencing to exclude wildlife; the minimization of oil on the free water surface (through headworks and tanks to separate oil, absorbent booms at evaporative pond inlets, etc.); the installation and operation of a leak-detection system; and prevention of surface water ingress or discharges to surface waters. Additionally, as stated in Section 2.2.4 (Water Supply and Disposal) Gasco would use deterrent measures such as gas-operated exploders, electronically produced bird distress calls, and visual deterrents such as scarecrows, flagging, lights, and balloons to reduce the amount of wildlife use at the pond.

Perimeter fencing would serve to exclude large wildlife, such as big game and many non-game species, from accessing the ponds, thereby minimizing impacts to those species. However, volant wildlife such as birds and bats could access the ponds by flying over the fence. Although the deterrents described above would serve to reduce pond use by these species, the efficacy of each of these deterrent systems varies. All instances of wildlife mortality would be reported to the BLM in order to assess the actual effectiveness of the deterrents. If it is determined that local populations have become habituated to the deterrents or they have become otherwise ineffective additional deterrent or exclusion measures (e.g., netting) may be required. Effects of evaporation facilities on bird and bat species as well as deterrent effectiveness are discussed below.

4.16.1.1.6.1 Effects on Birds

The MBTA prohibits any "take" of migratory birds. The definition of take includes the killing, possessing, or collecting of migratory birds. Most birds found in the Uinta Basin are listed as migratory birds with the exception of English sparrows, European starlings, rock doves (common pigeons), and birds commonly referred to as upland game birds such as pheasants, chukars, and grouse. All migratory birds killed as a result of contact with toxic or hazardous materials constitute violations of the MBTA.

Birds, including hawks, owls, waterfowl, and songbirds, can be attracted to wastewater evaporation ponds because they resemble natural water bodies. The ingestion of high concentrations of salts in these ponds (hypersaline water) can cause mortality from salt toxicosis (sodium toxicity; Windingstad et al. 1987). Ingestion of toxic water can also induce negative chronic health effects on aquatic birds. Additionally, sodium intoxication can cause neurological impairment resulting in the bird's inability to hold its head upright and ultimately causing it to drown (Meteyer et al. 1997).

Externally, corrosion inhibitors, surfactants, and sodium in the hypersaline water can crystalize on bird feathers thereby destroying the feathers' heat regulation and buoyancy functions. When a bird comes into contact with water containing these toxins the surface tension of the natural oils on the bird's feathers is reduced. This allows water to penetrate through the feathers and onto the skin, and subjects the bird to hypothermia (Lustick 1976). The loss of natural oils as well as salt crystallization build-up on the feathers destroys the buoyant properties of feathers and causes the bird to drown.

Gas-operated exploders have proven relatively effective as an avian deterrent (Read 1999; Ronconi and St. Clair 2006). However, the effectiveness depends on a variety of factors, including the targeted species, numbers of birds present, availability of alternative sites for repelled birds, density of exploders, interval between explosions, and wind conditions (Marsh et al. 1991). It has been shown that individuals can become habituated to the explosions over time (Bomford and O'Brien 1990). Electronically produced distress calls and visual deterrents tend to have effectual results initially, but birds are often habituated to these deterrents, potentially rendering them ineffective (Belant et al. 1998; Esmoil and Anderson 1995; James et al. 1999; Marsh et al. 1991).

4.16.1.1.6.2 Effects on Bats

Most temperate climate bat species must drink water (Neuweiler 2000; O'Farrell et al. 1971). Bats drink while flying by skimming over water and dipping either their face or tongue into the water's surface (Adams and Simmons 2002). The proximity of water is important to most species, primarily for drinking, but also because moist habitats typically support higher insect concentrations and North American bat species are primarily insectivores (Fukui et al. 2006; Jackrel and Matlack 2010). Because bats locate water sources through echolocation, they could be attracted to an evaporation pond because it resembles a natural water source.

Although the exact effects on bats of the ingestion of high doses of salt, surfactant, and other chemicals with the potential to be found in the evaporation pond are unknown, it is likely that internal effects similar to those described for birds could occur. Additionally, because bats eat aquatic insects that may emerge from the ponds they are also susceptible to bioaccumulation of certain toxins (Brix et al. 2000; Peterson and Nebeker 1992). As described in Section 2.9.2 (Wells for Subsurface Water Disposal), the water in the evaporation ponds will likely be of poor quality because of high TDS and a high concentration of salt. Studies documenting aquatic invertebrate diversity have found that species diversity is generally low in hypersaline evaporation ponds. However a few insect species that may be palatable to bats could emerge from briny ponds, such as brine flies (*Ephydra gracilis*) and some species of midges (*Chronomidae*) (Euliss and Jarvis 1991; Herbst 2006; Tanner et al. 1999). The extent of impacts to bats from bioaccumulation of toxins through the ingestion of aquatic insects would hinge on the amount and diversity of insects able to emerge from the ponds.

The deterrents systems that would be installed at the evaporation pond site would likely have low effectiveness for bat species. Because bats are nocturnal, visual deterrents such as flagging, scarecrows, and balloons would be ineffective. The efficacy of many auditory deterrents, such as gas-operated exploders, has not been studied on bats.

4.16.1.1.6.3 Risk Assessment

Through the installation of deterrents, potential impacts as described above would be minimized to birds, but would likely still impact the health of local bat populations. Assuming that greater surface area of evaporative facilities leads to greater risk of contact with water in evaporative ponds, it is possible to assess the risk of the direct adverse long-term effects on wildlife under each alternative. Under the Proposed Action, approximately 143 acres of evaporative facilities would be built in the northeastern portion of the project area. This is approximately 2.5 times the area devoted to evaporative facilities under the No Action Alternative, where 57 acres of evaporative facilities would be built (see Table 4-140).

4.16.1.1.7 Effects of Habitat Fragmentation on Wildlife

In addition to directly disturbing wildlife habitat, roads associated with undisturbed habitat adjacent to areas fragmented by natural gas development, would degrade that habitat's value to wildlife and cause animal displacement. The degree of animal displacement and reduction in habitat value would vary depending on the species, habitat types, vegetative cover, topography, existing population size, winter snow conditions, animal health, traffic levels, and the amount of noise and frequency of human presence. Habitat fragmentation may be less obvious than direct impacts such as vehicle collisions with wildlife or vegetation removal, but often carries considerable consequences for long-term population and reproductive success. Large expanses of habitat may be necessary to meet the minimum requirements of the largest, most widely roaming species, such as top-level carnivores and large migrating herd animals.

Many variables that contribute to the severity of the impacts to wildlife are difficult to predict. Such variables include vehicle use per hour and day, vehicle speed, noise per vehicle, frequency of drivers exiting their vehicles, etc. Unless otherwise stated, for purposes of this analysis it is assumed that all roads (existing and proposed) in the project area would have equal impact on wildlife species.

The impacts of habitat fragmentation from natural gas development in the project area were analyzed for deer, elk, and bighorn sheep. These were selected for analysis because they are high-interest species; there are peer-reviewed studies available that provide fragmentation thresholds to assess impacts to the species; and GIS data were available to support analyses. Additionally, these species are representative of key habitat types in the project area and therefore provide a comparative analysis of fragmentation impacts that would be applicable for other species in the project area as well.

4.16.1.1.7.1 General Methodology

GIS models were created to analyze the degree of habitat fragmentation under each alternative for BLM-designated and UDWR habitat. Models were based on the BLM's best available GIS data for existing roads in the project area. For mule deer, elk, and bighorn sheep, the models used both (separately) BLM-designated and UDWR habitat acreages for each species. Individual well pads were considered as endpoints for (and therefore part of) proposed roads. Pipelines were assumed to have minimal effect on fragmentation, because more than 99% of proposed pipelines (under all alternatives) run along roads and are therefore accounted for by analyzing road effects.

The distribution of new roads was determined through the alternatives development process. Existing roads would be used under each alternative and therefore the habitat fragmentation analysis considered the effects, on each wildlife species examined, of existing roads along with proposed new roads in the project area. Model runs involved habitat fragmentation calculations where habitat coverages were combined with well and road distribution coverages to determine fragment acreages by alternative and species.

4.16.1.1.7.2 Analysis of Habitat Fragmentation Impacts to Wildlife

Mule Deer

Sawyer et al. (2006) found that mule deer preferentially use habitat where road densities are ≤0.16 kilometers per square kilometer (km/km^2) in a natural gas field in western Wyoming. Accordingly, for the purposes of this analysis, all habitats where road density would exceed 0.16 km/km^2 were considered unfavorable.

Taking into account only existing roads, 145,939 acres (71%) of BLM-designated and 49,858 acres (62%) of UDWR mule deer habitat in the project area are currently unfavorable due to habitat fragmentation. Under the Proposed Action, approximately 87% (178,806 acres) of the BLM-designated habitat and 81% (65,312 acres) of the UDWR mule deer habitat in the project area would be unfavorable to mule deer due to existing and proposed roads (a 23% increase in habitat fragmentation in BLM-designated habitat, and a 31% increase in habitat fragmentation in UDWR habitat over current conditions). By comparison, 76% (156,910 acres) of BLM-designated habitat and 67% (53,829 acres) of UDWR mule deer habitat in the project area would be unfavorable to mule deer due to existing and proposed roads (a 7% increase in habitat fragmentation in BLM-designated habitat, and an 8% increase in habitat fragmentation in UDWR habitat over current conditions) under the No Action Alternative (Table 4-146 and Table 4-147).

Table 4-146. Acres and Percentage of BLM-designated Mule Deer Habitat in the Project Area Unfavorable Due to Habitat Fragmentation

	Existing Conditions	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Mule deer habitat unfavorable (acres)	145,939	178,806	173,079	199,636	156,910	164,795	174,372
Mule deer habitat unfavorable (%)	71%	87%	84%	97%	76%	80%	84%
Total miles of roads (existing and proposed new road miles)	560	885	833	1,097	631	666	757

Table 4-147. Acres and Percentage of UDWR Mule Deer Habitat in the Project Area Unfavorable Due to Habitat Fragmentation

	Existing Conditions	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Mule deer habitat unfavorable (acres)	49,858	65,312	62,011	75,393	53,829	57,208	64,148
Mule deer habitat unfavorable (%)	62%	81%	77%	93%	67%	71%	79%
Total miles of roads (existing and proposed new road miles)	190	301	280	393	209	223	271

Mule deer avoidance of this fragmented habitat would be more likely where habitat fragmentation occurs in more open habitats such as sagebrush, and less likely in denser cover, such as pinyon-juniper woodlands. Topography near the roads would also influence avoidance levels, an example of which would be providing cover from a road where construction occurs along a hillside (Forman et al. 2003).

Elk

Lyon (1983) found that elk preferentially use habitat where road densities are ≤ 0.62 km/km^2. Accordingly, for the purposes of this analysis, all habitat where road density would exceed 0.62 km/km^2 was considered unfavorable.

Taking into account only existing roads, 124,188 acres (60%) of BLM-designated and 58,882 acres (53%) of UDWR elk habitat in the project area are currently unfavorable due to habitat fragmentation. Under the Proposed Action, approximately 78% (161,570 acres) of BLM-designated and 73% (81,078 acres) of UDWR elk habitat in the project area would be unfavorable to elk due to existing and proposed roads (a 30% increase in habitat fragmentation in BLM-designated habitat a 38% increase in habitat fragmentation in UDWR habitat over current conditions). Under the No Action alternative, 66% (135,678 acres) of BLM-designated and 57% (63,585 acres) of UDWR elk habitat would be unfavorable (a 10% increase in habitat fragmentation in BLM-designated habitat, and an 8% increase in habitat fragmentation in UDWR habitat over current conditions) to elk due to existing and proposed roads (Table 4-148 and Table 4-149).

Table 4-148. Acres and Percentage of BLM-designated Elk Habitat in the Project Area Unfavorable Due to Habitat Fragmentation

	Existing Conditions	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Elk habitat unfavorable (acres)	124,188	161,570	154,350	192,880	135,678	141,413	154,120
Elk habitat unfavorable (%)	60%	78%	75%	93%	66%	68%	75%
Total miles of roads (existing and proposed new road miles)	560	885	835	1,096	633	666	757

Table 4-149. Acres and Percentage of UDWR Elk Habitat in the Project Area Unfavorable Due to Habitat Fragmentation

	Existing Conditions	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternativ F (Agency Preferred)
Elk habitat unfavorable (acres)	58,882	81,078	78,662	104,076	63,585	69,168	77,473
Elk habitat unfavorable (%)	53%	73%	71%	93%	57%	62%	70%
Total miles of roads (existing and proposed new road miles)	256	405	387	558	282	308	112

As with mule deer, elk avoidance would be more likely in fragmented open habitat such as sagebrush, and less likely in denser cover such as pinyon-juniper woodlands. Topography near the roads would also influence avoidance levels, an example of which would be providing cover from a road where construction occurs along a hillside (Forman et al. 2003).

Bighorn Sheep

Singer et al. (2001) found that bighorn sheep released into habitat patches of at least 158.7 $km^2 \pm$ 60.3 km^2 colonized an average of one neighboring patch, while bighorn sheep released in smaller patches did not colonize neighboring areas and eventually left the area. Patch colonization is a necessary precursor to reproduction and population maintenance. Bighorn sheep are more sensitive to encroachment and habitat fragmentation than are other ungulates in the project area (Singer et al. 2001). Accordingly, this analysis assumed that patch sizes smaller than 159 km^2 were generally unsuitably fragmented, and therefore unfavorable for bighorn sheep.

Taking into account only existing roads, 81,123 acres (100%) of BLM-designated and 38,973 acres (100%) of UDWR bighorn sheep habitat in the project area are currently unfavorable due to habitat fragmentation. Under the Proposed Action, all BLM-designated and UDWR bighorn sheep habitat would remain unsuitably fragmented as there would be no habitat patch sizes greater than 159 km^2 (Table 4-150 and Table 4-151). There would be an additional 162 miles of new roads (331 total miles of roads) in BLM-designated habitat (see Table 4-143) and 53 miles of new roads (135 total miles of roads) in UDWR habitat (see Table 4-144). The No Action Alternative would result in the fewest miles of new roads (17 miles in BLM-designated and 8 miles in UDWR bighorn sheep habitat; see Table 4-143 and Table 4-144), and would therefore provide the greatest amount of potentially suitable bighorn sheep habitat, even though no habitat patch sizes greater than 159 km^2 would occur (see Table 4-150 and Table 4-151).

Table 4-150. Acres of BLM-designated Rocky Mountain Bighorn Sheep Habitat in Patches <159 km^2, Percent Habitat Unfavorable, and Total Miles of Roads in BLM-designated Habitat

	Existing Conditions	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Habitat in patches <159 km^2 (acres)	81,123	81,123	81,123	81,123	81,123	81,123	80,162
Habitat unfavorable (%)	100%	100%	100%	100%	100%	100%	100%
Total miles of roads (existing and proposed new road miles)	169	331	270	388	186	205	270

Table 4-151. Acres of UDWR Rocky Mountain Bighorn Sheep Habitat in Patches <159 km^2 and Percent Habitat Unfavorable

	Existing Conditions	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Habitat in patches <159 km^2 (acres)	38,973	38,973	38,973	38,973	38,973	38,973	38,559
Habitat unfavorable (%)	100%	100%	100%	100%	100%	100%	100%
Total miles of roads (existing and proposed new road miles)	82	135	118	186	90	93	116

4.16.1.2 ALTERNATIVE B: REDUCED DEVELOPMENT

Under Alternative B, 1,114 new natural gas wells would be drilled, requiring approximately 274 miles of new roads and 393 miles of new pipelines. Approximately 135 acres of evaporative facilities for produced groundwater would also be required. Total acres of disturbance under Alternative B would be approximately 5,685. New natural gas wells under Alternative B represent a threefold increase in the project area compared to the No Action Alternative. Acres of evaporative facilities and total acres of disturbance would be nearly 2.5 times greater under Alternative B than under the No Action Alternative. Finally, there would be approximately 4 times more miles of new roads, and just below 1.5 times more miles of new pipeline, under Alternative B than under the No Action Alternative (see Table 4-140).

4.16.1.2.1 BIG GAME

4.16.1.2.1.1 Mule Deer

Approximately 5,685 acres of BLM-designated mule deer habitat would be lost due to natural gas development under Alternative B. This represents approximately 3% of the BLM-designated mule deer habitat in the project area. Acres of disturbance in BLM-designated mule deer habitat would be approximately 3 times greater under Alternative B than under the No Action Alternative, where acres of disturbance would be approximately 2,054 (see Table 4-141). In UDWR mule deer habitat, Alternative B would disturb approximately 1,583 acres (2% of the total UDWR mule deer habitat in the project area) during construction of well pads, new roads, and evaporative facilities (see Table 4-142). This is more than 3 times the habitat loss than under the No Action Alternative, where approximately 476 acres (0.6%) of surface disturbance would occur in UDWR mule deer habitat.

There would be 273 miles of new roads in BLM-designated mule deer habitat under Alternative B, approximately 4 times greater than under the No Action Alternative (see Table 4-143) and approximately 49% more than current conditions. In UDWR mule deer habitat, there would be 90 miles of new roads under Alternative B, nearly 5 times more than under the No Action Alternative (see Table 4-144) and approximately 47% more than current conditions. Under Alternative B, traffic volume in the project area is expected to increase by a maximum of 4.8%, compared to a maximum increase of 1.2% under the No Action Alternative (see Table 4-145). This estimated increase in traffic volume is the same for all big game and other species, and is not repeated in the sections below. (See Section 4.5 for additional detail on traffic volume.)

4.16.1.2.1.2 Elk

Under Alternative B, 5,685 acres of BLM-designated elk habitat would be disrupted by well pads, roads, and evaporative facilities. This represents approximately 3% of the total BLM-designated elk habitat in the project area. Acres of disturbance in BLM-designated elk habitat would be approximately 3 times greater under Alternative B than under the No Action Alternative, where disturbance would impact approximately 2,055 acres (see Table 4-141). In UDWR elk habitat, Alternative B would remove approximately 2,292 acres (2% of the total UDWR elk habitat in the project area) during construction of well pads, new roads, and evaporative facilities (see Table 4-142). This is more than 3 times more habitat loss than under the No Action Alternative, where approximately 675 acres (0.6%) of surface disturbance would occur in UDWR elk habitat.

There would be 273 miles of new roads in BLM-designated elk habitat under Alternative B, approximately 4 times more than under the No Action Alternative (see Table 4-143) and approximately 49% more than current conditions. In UDWR elk habitat, there would be 131 miles of new roads under Alternative B, approximately 5 times greater than under the No Action Alternative (see Table 4-144) and approximately 51% more than current conditions.

4.16.1.2.1.3 Pronghorn Antelope

Approximately 5,681 acres of BLM-designated pronghorn antelope habitat would be converted to well pads, roads, and evaporative facilities under Alternative B. This represents approximately 3% of the total BLM-designated pronghorn antelope habitat in the project area. Acres of disturbance in BLM-designated pronghorn antelope habitat would be approximately 3 times greater under Alternative B than under the No Action Alternative, where acres of disturbance would be approximately 2,055 (see Table 4-141). In UDWR pronghorn antelope habitat, Alternative B would remove approximately 3,513 acres (3.3% of the total UDWR pronghorn antelope habitat in the project area) during construction of well pads, new roads, and evaporative facilities (see Table 4-142). This is more than twice the habitat loss of the No Action Alternative, where approximately 1,472 acres (1.4%) of surface disturbance would occur in UDWR pronghorn antelope habitat.

There would be 273 miles of new roads in BLM-designated pronghorn antelope habitat under Alternative B, approximately 4 times more than under the No Action Alternative (see Table 4-143) and approximately 49% more than current conditions. In UDWR pronghorn antelope habitat, there would be 153 miles of new roads under Alternative B, approximately 3 times more than under the No Action Alternative (see Table 4-144) and approximately 44% more than current conditions.

4.16.1.2.1.4 Rocky Mountain Bighorn Sheep

Under Alternative B, 1,780 acres of BLM-designated bighorn sheep habitat would be disturbed by well pads and roads. This represents approximately 2% of bighorn sheep habitat in the project area. Acres of disturbance in BLM-designated bighorn sheep habitat would be 5 times greater under Alternative B than under the No Action Alternative, where acres of disturbance would be approximately 356 (see Table 4-141). In UDWR bighorn sheep habitat, Alternative B would remove approximately 688 acres (1.8% of the total UDWR bighorn sheep habitat in the project area) during construction of well pads and new roads (see Table 4-142). This is more than 3 times more habitat loss than under the No Action Alternative, where approximately 216 acres (0.6%) of surface disturbance would occur in UDWR bighorn sheep habitat.

There would be 101 miles of new roads in BLM-designated bighorn sheep habitat under Alternative B, nearly 6 times more than under the No Action Alternative (see Table 4-143) and 60% more than current conditions. In UDWR bighorn sheep habitat, there would be 36 miles of new roads under Alternative B, approximately 4.5 times greater than under the No Action Alternative (see Table 4-144) and approximately 44% more than current conditions.

4.16.1.2.2 Mountain Lion (Cougar)

Assuming that the local mountain lion population is closely associated with the migratory mule deer herd, and that the lion population is currently stable, the magnitude of impacts to mountain lions under Alternative B would be the same as the magnitude of impacts to mule deer as described above.

4.16.1.2.3 Upland Game

Under Alternative B, upland game would incur direct long-term adverse impacts from the loss of 5,685 acres (2.7%) of habitat and from disturbances associated with 274 miles (a 49% increase over current conditions) of new roads. Impacts would be greater under Alternative B than under the No Action Alternative, because approximately 3 times more habitat loss and 4 times more miles of new roads would be created under Alternative B than under the No Action Alternative (see Table 4-140).

4.16.1.2.4 Reptiles, Amphibians, and Other Non-game Species

Under the Alternative B, impacts to reptiles and other non-game species would be the same as impacts to upland game (see Section 4.16.1.2.3).

No disturbance would occur in wetland/riparian areas under Alternative B, so there would be no direct impacts to amphibians. This is the same as under the No Action Alternative. Indirect impacts to amphibians under Alternative B would be similar to the Proposed Action. Indirect impacts to amphibians would be greater under Alternative B than under the No Action Alternative, because greater disturbance would occur under Alternative B. (See Section 4.15, Water Resources, for a discussion of direct and indirect effects on water resources.)

4.16.1.2.5 Effects of Evaporative Facilities on Wildlife

Under Alternative B, 135 acres of evaporative facilities would be constructed. This is nearly 2.5 times more surface area for evaporative facilities than under the No Action Alternative. As described under the Proposed Action, effects on wildlife would be minimized due to compliance with BLM Onshore Order #7, the use of deterrents, and monitoring (see Table 4-140).

4.16.1.2.6 Effects of Habitat Fragmentation on Wildlife

4.16.1.2.6.1 Mule Deer

Approximately 173,079 acres (84%) of BLM-designated mule deer habitat in the project area would be unfavorable to mule deer due to existing and proposed roads under Alternative B. This is approximately 10% more unfavorable BLM-designated mule deer habitat than under the No Action Alternative (see Table 4-146), and 18% more than under current conditions. Approximately 62,011 acres (77%) of UDWR mule deer habitat in the project area would be unfavorable to mule deer due to existing and proposed roads under Alternative B. This is approximately 15% more unfavorable UDWR mule deer habitat than under the No Action Alternative, and 24% more than under current conditions (see Table 4-147).

4.16.1.2.6.2 Elk

Under Alternative B, approximately 154,350 acres (75%) of BLM-designated elk habitat in the project area would be unfavorable to elk due to existing and proposed roads. This is approximately 14% more unfavorable BLM-designated elk habitat than under the No Action Alternative (see Table 4-148), and 25% more than under current conditions. Approximately 78,662 acres (71%) of UDWR elk habitat in the project area would be unfavorable to elk due to existing and proposed roads under Alternative B. This is approximately 24% more unfavorable UDWR elk habitat than under the No Action Alternative, and 34% more than under current conditions (see Table 4-149).

4.16.1.2.6.3 Bighorn Sheep

Under current conditions, 100% of the BLM-designated and UDWR bighorn sheep habitat in the project area is unsuitably fragmented due to existing roads (see Table 4-150 and Table 4-151). Under Alternative B, all of the BLM-designated and UDWR bighorn sheep habitat would continue to be unsuitably fragmented as there would be no habitat patch sizes greater than 159 km2. No habitat patch sizes greater than 159 km2 would occur under the No Action Alternative either. However, the No Action Alternative would result in nearly 6 times fewer miles of new roads (17 miles of new roads under the No Action Alternative) in BLM-designated bighorn sheep habitat than under Alternative B (101 miles of new roads under Alternative B) (see Table 4-143). Likewise, in UDWR bighorn sheep habitat the No Action Alternative would result in 4.5 times fewer miles of new roads (8 miles of new roads under the No Action Alternative) than under Alternative B (36 miles of new roads under Alternative B) (see Table 4-144).

4.16.1.3 ALTERNATIVE C: FULL DEVELOPMENT

Under Alternative C, 1,887 new natural gas wells would be drilled. This level of new well development would require approximately 526 miles of new roads, 861 miles of new pipelines, and 271 acres of evaporative facilities for produced groundwater. Total acres of disturbance under Alternative C would be approximately 9,982. The number of new wells under Alternative C would be more than 5 times more than under the No Action Alternative. New well development under Alternative C would result in more than 7 times the miles of new roads, approximately 3 times more miles of new pipelines, approximately 5 times more acres of evaporative facilities, and approximately 5 times more total surface disturbance than under the No Action Alternative (see Table 4-140).

4.16.1.3.1 BIG GAME

4.16.1.3.1.1 Mule Deer

Approximately 9,977 acres of BLM-designated mule deer habitat would be lost due to natural gas development under Alternative C. This represents approximately 5% of the BLM-designated mule deer habitat in the project area. Acres of disturbance in BLM-designated mule deer habitat would be approximately 5 times greater under Alternative C than under the No Action Alternative, where acres of disturbance would be approximately 2,054 (see Table 4-141). In UDWR mule deer habitat, Alternative C would remove approximately 3,168 acres (4% of the total UDWR mule deer habitat in the project area) during construction of well pads, new roads, and evaporative facilities (see Table 4-142). This is more than 6.5 times the habitat loss than under the No Action Alternative, where approximately 476 acres (0.6%) of surface disturbance would occur in UDWR mule deer habitat.

There would be 537 miles of new roads in BLM-designated mule deer habitat under Alternative C, approximately 8 times more than under the No Action Alternative (see Table 4-143) and 96% more than under current conditions. In UDWR mule deer habitat, there would be 203 miles of new roads under Alternative C, approximately 10.5 times greater than under the No Action Alternative (see Table 4-144) and approximately double current conditions. Under Alternative C traffic volume in the project area is expected to increase by a maximum of 6.2%, compared to a maximum increase of 1.2% under the No Action Alternative (see Table 4-145). This estimated increase in traffic volume is the same for all big game and other species and is not repeated in the sections below. (See Section 4.5 for additional detail on traffic volume.)

4.16.1.3.1.2 Elk

Under Alternative C, 9,979 acres of BLM-designated elk habitat would be impacted by well pads, roads, and evaporative facilities. This represents approximately 5% of the total BLM-designated elk habitat in the project area. Acres of disturbance in BLM-designated elk habitat would be approximately 5 times greater under Alternative C than under the No Action Alternative, where acres of disturbance would be approximately 2,055 (see Table 4-141). In UDWR elk habitat, Alternative C would remove approximately 4,861 acres (4.4% of the total UDWR elk habitat in the project area) during construction of well pads, new roads, and evaporative facilities (see Table 4-142). This is more than 7 times the habitat loss than under the No Action Alternative, where approximately 675 acres (0.6%) of surface disturbance would occur.

There would be 536 miles of new roads in BLM-designated elk habitat under Alternative C, approximately 8 times more than under the No Action Alternative (see Table 4-143), and 96% more than under current conditions. In UDWR elk habitat, there would be 302 miles of new roads under Alternative C, more than 11 times greater than under the No Action Alternative (see Table 4-144), and more than double current conditions.

4.16.1.3.1.3 Pronghorn Antelope

Approximately 9,925 acres of BLM-designated pronghorn antelope habitat would be converted to well pads, roads, and evaporative facilities under Alternative C. This represents approximately 5% of the total BLM-designated pronghorn antelope habitat in the project area. Acres of disturbance in BLM-designated pronghorn antelope habitat would be approximately 5 times greater under Alternative C than under the No Action Alternative, where acres of disturbance would be approximately 2,055 (see Table 4-141). In UDWR pronghorn antelope habitat, Alternative C would remove approximately 5,875 acres (5.6% of the total UDWR pronghorn antelope habitat in the project area) during construction of well pads, new roads, and evaporative facilities (see Table 4-142). This is approximately 4 times more habitat loss than under the No Action Alternative, where approximately 1,472 acres (1.4%) of surface disturbance would occur in UDWR pronghorn antelope habitat.

There would be 535 miles of new roads in BLM-designated pronghorn antelope habitat under Alternative C, more than 7 times the number under the No Action Alternative (see Table 4-143), and 97% more than under current conditions. In UDWR pronghorn antelope habitat, there would be 285 miles of new roads under Alternative C, approximately 6 times greater than under the No Action Alternative (see Table 4-144), and approximately 83% more than current conditions.

4.16.1.3.1.4 Rocky Mountain Bighorn Sheep

Under Alternative C, 3,194 acres of BLM-designated bighorn sheep habitat would be converted to well pads and roads. This represents approximately 4% of bighorn sheep habitat in the project area. Acres of disturbance in BLM-designated bighorn sheep habitat would be nearly 9 times greater under Alternative C than under the No Action Alternative where acres of disturbance would be approximately 356 (see Table 4-141). In UDWR bighorn sheep habitat Alternative C would remove approximately 1,570 acres (4% of the total UDWR bighorn sheep habitat in the project area) during construction of well pads and new roads (see Table 4-142). This is more than 7 times more habitat loss than under the No Action Alternative, where approximately 216 acres (0.6%) of surface disturbance would occur in UDWR bighorn sheep habitat.

There would be 219 miles of new roads in BLM-designated bighorn sheep habitat under Alternative C, nearly 13 times more than under the No Action Alternative (see Table 4-143) and 130% more than under current conditions. In UDWR bighorn sheep habitat, there would be 104 miles of new roads under Alternative C, 13 times greater than under the No Action Alternative (see Table 4-144), and more than double current conditions.

4.16.1.3.2 Mountain Lion (Cougar)

Assuming that the local mountain lion population is closely associated with the migratory mule deer herd, and that the lion population is currently stable, the magnitude of impacts to mountain lions under Alternative C would be the same as the magnitude of impacts to mule deer, as described above.

4.16.1.3.3 Upland Game

Under Alternative C, upland game would incur direct long-term adverse impacts from the loss of 9,982 acres (4.8%) of habitat and from disturbances associated with 526 miles of new roads (a 94% increase over current conditions). Impacts would be greater under Alternative C than under the No Action Alternative because nearly 5 times more habitat loss and more than 7 times the miles of new roads would be created under Alternative C than under No Action (see Table 4-140).

4.16.1.3.4 Reptiles, Amphibians, and Other Non-game Species

Under the Alternative C, impacts to reptiles and other non-game species would be the same as impacts to upland game (see Section 4.16.1.3.3).

Direct impacts to amphibians under Alternative C would be similar in nature to the Proposed Action, but would occur to a lesser degree because 4 acres of disturbance would occur in wetlands/riparian areas compared to 11 acres of disturbance under the Proposed Action. Indirect impacts would be similar to the Proposed Action. Direct and indirect impacts of Alternative C would be greater than the No Action Alternative, because more disturbance would occur under Alternative C than under the No Action Alternative. (See Section 4.15, Water Resources, for a discussion of direct and indirect effects on water resources.)

4.16.1.3.5 *EFFECTS OF EVAPORATIVE FACILITIES ON WILDLIFE*

Under Alternative C, 271 acres of evaporative facilities would be constructed. These facilities would have the same impacts on wildlife as discussed under the Proposed Action, but would affect a larger area. Under Alternative C, evaporative facilities would impact approximately 5 times more surface area than under the No Action Alternative (see Table 4-140). As described under the Proposed Action, effects on wildlife would be minimized due to compliance with BLM Onshore Order #7, the use of deterrents, and monitoring.

4.16.1.3.6 *EFFECTS OF HABITAT FRAGMENTATION ON WILDLIFE*

4.16.1.3.6.1 Mule Deer

Approximately 199,636 acres (97%) of BLM-designated mule deer habitat in the project area would be unfavorable to mule deer due to habitat fragmentation from existing and proposed roads under Alternative C. This is approximately 22% more unfavorable BLM-designated mule deer habitat than under the No Action Alternative (see Table 4-146), and 37% more than under current conditions. Approximately 75,393 acres (93%) of UDWR mule deer habitat in the project area would be unfavorable to mule deer, due to existing and proposed roads under Alternative C. This is approximately 40% more unfavorable UDWR mule deer habitat than under the No Action Alternative, and 51% more than under current conditions (see Table 4-147).

4.16.1.3.6.2 Elk

Under Alternative C, approximately 192,880 acres (93%) of BLM-designated elk habitat in the project area would be unfavorable to elk due to habitat fragmentation from existing and proposed roads. This is approximately 29% more unfavorable BLM-designated elk habitat than under the No Action Alternative (see Table 4-148), and 55% more than under current conditions. Approximately 104,076 acres (93%) of UDWR elk habitat in the project area would be unfavorable to elk due to existing and proposed roads under Alternative C. This is approximately 64% more unfavorable UDWR elk habitat than under the No Action Alternative, and 77% more than under current conditions (see Table 4-149).

4.16.1.3.6.3 Bighorn Sheep

Under current conditions, 100% of the BLM-designated and UDWR bighorn sheep habitat in the project area is unsuitably fragmented due to existing roads (see Table 4-150 and Table 4-151). Under Alternative C, all of the BLM-designated and UDWR bighorn sheep habitat would continue to be unsuitably fragmented as there would be no habitat patch sizes greater than 159 km^2. No habitat patch sizes greater than 159 km^2 would occur under the No Action Alternative either. However, the No Action Alternative would result in nearly 13 times fewer miles of new roads (17 miles of new roads under the No Action Alternative) in BLM-designated bighorn sheep habitat than under Alternative C, which would result in 219 miles of new roads (see Table 4-143). Likewise, in UDWR bighorn sheep habitat, the No Action Alternative would result in 13 times fewer miles of new roads (8 miles) than under Alternative C, which would result in 104 miles of new roads (see Table 4-144).

4.16.1.4 ALTERNATIVE D: NO ACTION

The No Action Alternative is the baseline to which the Proposed Action and the other alternatives are compared. Under the No Action Alternative, approximately 368 new natural gas wells would be drilled. This level of development would require approximately 72 miles of new roads, 316 miles of new pipelines, and 57 acres of evaporative facilities. Total acres of disturbance under the No Action Alternative would be approximately 2,055 (see Table 4-140). Impacts from well pads, roads, pipelines, and evaporative facilities would be fewer under the No Action Alternative than under any other alternative.

4.16.1.4.1 BIG GAME

4.16.1.4.1.1 Mule Deer

Under the No Action Alternative, there would be approximately 2,054 acres (1%) of BLM-designated mule deer habitat loss in the project area due to construction of well pads, roads, and evaporative facilities (see Table 4-141). In UDWR mule deer habitat, the No Action Alternative would impact approximately 476 acres (0.6% of the total UDWR mule deer habitat in the project area) during construction of well pads, new roads, and evaporative facilities (see Table 4-142).

Road impacts to mule deer would result from the construction of 71 miles of new roads in BLM-designated mule deer habitat in the project area under the No Action Alternative (see Table 4-143). This is a 13% increase over current conditions. In UDWR mule deer habitat, there would be 19 miles of new roads under the No Action Alternative (see Table 4-144). This is 10% more than under current conditions. Under the No Action Alternative, traffic volume in the project area is expected to increase by a maximum of 1.2% (see Table 4-145). This estimated increase in traffic volume is the same for all big game and other species, and is not repeated in the sections below. (See Section 4.5, for additional detail on traffic volume.)

4.16.1.4.1.2 Elk

Approximately 2,055 acres of BLM-designated elk habitat would be lost due to natural gas development under the No Action Alternative (see Table 4-141). This represents approximately 1% of the BLM-designated elk habitat in the project area. In UDWR elk habitat, the No Action Alternative would remove approximately 675 acres (0.6% of the total UDWR elk habitat in the project area) during construction of well pads, new roads, and evaporative facilities (see Table 4-142).

Impacts to elk would result from the construction of 73 miles of new roads in BLM-designated elk habitat in the project area under the No Action Alternative (see Table 4-143). This is a 13% increase over current conditions. In UDWR elk habitat, there would be 27 miles of new roads under the No Action Alternative (see Table 4-144) This is 10% more than under current conditions.

4.16.1.4.1.3 Pronghorn Antelope

Approximately 2,055 acres of BLM-designated pronghorn antelope habitat would be impacted by well pads, roads, and evaporative facilities under the No Action Alternative. This represents approximately 1% of the total BLM-designated pronghorn antelope habitat in the project area (see Table 4-141). In UDWR pronghorn antelope habitat, the No Action Alternative would remove approximately 1,472 acres (1.4% of the total UDWR pronghorn antelope habitat in the project area) during construction of well pads, new roads, and evaporative facilities (see Table 4-142).

Impacts to pronghorn antelope would result from the construction of 72 miles of new roads in BLM-designated pronghorn antelope habitat in the project area under the No Action Alternative (see Table 4-143). This is a 13% increase over current conditions. In UDWR pronghorn antelope habitat, there would be 48 miles of new roads under the No Action Alternative (see Table 4-144). This is approximately 14% more than under current conditions.

4.16.1.4.1.4 Rocky Mountain Bighorn Sheep

Under the No Action Alternative, 356 acres of BLM-designated bighorn sheep habitat would be impacted by well pads and roads. This represents 0.44% of BLM-designated bighorn sheep habitat in the project area (see Table 4-141). In UDWR bighorn sheep habitat, the No Action Alternative would remove approximately 216 acres (0.6% of the total UDWR bighorn sheep habitat in the project area) during construction of well pads and new roads (see Table 4-142).

Road impacts to bighorn sheep would result from the construction of 17 miles of new roads in BLM-designated bighorn sheep habitat in the project area under the No Action Alternative (see Table 4-143). This is a 10% increase over current conditions. In UDWR bighorn sheep habitat, there would be 8 miles of new roads under the No Action Alternative (see Table 4-144). This is approximately 10% more than under current conditions.

4.16.1.4.2 Mountain Lion (Cougar)

Assuming that the local mountain lion population is closely associated with the migratory mule deer herd, and that the lion population is currently stable, the magnitude of impacts to mountain lions under the No Action Alternative would be the same as the magnitude of impacts to mule deer as described above.

4.16.1.4.3 Upland Game

Under the No Action Alternative, upland game would incur direct, long-term adverse impacts from the loss of 2,055 acres (1%) of habitat, and from disturbances associated with 72 miles of new roads (see Table 4-140), a 13% increase over current conditions.

4.16.1.4.4 Reptiles, Amphibians, and Other Non-game Species

Under the No Action Alternative, impacts to reptiles and other non-game species would be the same as impacts to upland game (see Section 4.16.1.4.3).

Under the No Action Alternative, direct and indirect impacts to amphibians would be similar to the Proposed Action except to a lesser degree. There would be fewer acres of disturbance under the No Action Alternative than under any other alternative. Also, no disturbance would occur in wetlands/riparian areas under the No Action Alternative. (See Section 4.15, Water Resources, for a discussion of direct and indirect effects on water resources.)

4.16.1.4.5 Effects of Evaporative Facilities on Wildlife

Under the No Action Alternative, 57 acres of evaporative facilities would be constructed. This is less surface area for evaporative facilities than under any other alternative. These facilities would have the same general impacts to wildlife as described under the Proposed Action, although they would occur over a much smaller area (see Table 4-140). As described under the Proposed Action, effects on wildlife would be minimized due to compliance with BLM Onshore Order #7, the use of deterrents, and monitoring.

4.16.1.4.6 Effects of Habitat Fragmentation on Wildlife

4.16.1.4.6.1 Mule Deer

Under the No Action Alternative, 156,910 acres (76%) of BLM-designated mule deer habitat would be unfavorable for mule deer due to habitat fragmentation from existing and proposed roads (see Table 4-146). This is 7% more unfavorable BLM-designated mule deer habitat than under current conditions (71% unfavorable habitat). Approximately 53,829 acres (67%) of UDWR mule deer habitat in the project area would be unfavorable to mule deer due to existing and proposed roads under the No Action Alternative. This is approximately 8% more unfavorable UDWR mule deer habitat than under current conditions (see Table 4-147).

4.16.1.4.6.2 Elk

Under the No Action Alternative, 135,678 acres (66%) of BLM-designated elk habitat would be unfavorable for elk due to habitat fragmentation from existing and proposed roads (see Table 4-148). This is 10% more unfavorable BLM-designated elk habitat than under current conditions (60% unfavorable habitat). Approximately 63,585 acres (57%) of UDWR elk habitat in the project area would be unfavorable to elk due to existing and proposed roads under the No Action Alternative. This is approximately 8% more unfavorable UDWR elk habitat than under current conditions (see Table 4-149).

4.16.1.4.6.3 Bighorn Sheep

Under current conditions, 100% of the BLM-designated and UDWR bighorn sheep habitat in the project area is unsuitably fragmented due to existing roads (see Table 4-150 and Table 4-151). Under the No Action Alternative, all of the BLM-designated and UDWR bighorn sheep habitat would continue to be unsuitably fragmented, as there would be no habitat patch sizes greater than 159 km^2 (see Table 4-150 and Table 4-151). However, due to the relatively small number of new roads proposed in BLM-designated and UDWR bighorn sheep habitat under the No Action Alternative (17 miles in BLM-designated and 8 miles in UDWR bighorn sheep habitat; see Table 4-143), the largest amount of potentially suitable habitat would be expected compared to other alternatives. Seventeen miles of new roads in BLM-designated bighorn sheep habitat represents a 10% increase in miles of new roads in BLM-designated bighorn sheep habitat, compared to current conditions. Likewise, 8 miles of new roads in UDWR bighorn sheep habitat represents a 10% increase in miles of new roads in UDWR bighorn sheep habitat, compared to current conditions (see Table 4-144).

4.16.1.5 ALTERNATIVE E: REDUCED DEVELOPMENT WITH DIRECTIONAL DRILLING

Under Alternative E, 1,114 new natural gas wells would be drilled, requiring approximately 106 miles of new roads and 216 miles of new pipelines. Approximately 135 acres of evaporative facilities for produced groundwater would also be required. Total acres of disturbance under Alternative E would be approximately 2,175. New natural gas wells under Alternative E represent a threefold increase in new natural gas wells in the project area compared to the No Action Alternative. Approximately 47% more miles of new roads would occur under Alternative E compared to the No Action Alternative. On the other hand, there would be approximately 32% fewer miles of new pipelines under Alternative E than under the No Action Alternative. Acres of evaporative facilities would be nearly 2.5 times greater under Alternative E than under the No Action Alternative. Finally, there would be approximately 6% more total surface disturbance under Alternative E than under the No Action Alternative (see Table 4-140).

4.16.1.5.1 BIG GAME

4.16.1.5.1.1 Mule Deer

Approximately 2,173 acres (1%) of BLM-designated mule deer habitat in the project area would be lost due to natural gas development under Alternative E. Acres of disturbance in BLM-designated mule deer habitat would be approximately 6% greater under Alternative E than under the No Action Alternative, where acres of disturbance would be approximately 2,054 (see Table 4-141). In UDWR mule deer habitat in the project area, Alternative E would remove approximately 597 acres (0.7%) during construction of well pads, new roads, and evaporative facilities (see Table 4-142). This is approximately 25% more habitat loss than under the No Action Alternative, where approximately 476 acres (0.6%) of surface disturbance would occur in UDWR mule deer habitat.

There would be 106 miles of new roads in BLM-designated mule deer habitat under Alternative E, approximately 49% more than under the No Action Alternative (see Table 4-143) and approximately 19% more than current conditions. In UDWR mule deer habitat, there would be 33 miles of new roads under Alternative E, more than 1.5 times greater than under the No Action Alternative (see Table 4-144), and approximately 17% more than current conditions. Under Alternative E, traffic volume in the project area is expected to increase by a maximum of 4.8%, compared to a maximum increase of 1.2% under the No Action Alternative (see Table 4-145). This estimated increase in traffic volume is the same for all big game and other species and is not repeated in the sections below. (See Section 4.5 for additional detail on traffic volume.)

4.16.1.5.1.2 Elk

Under Alternative E, 2,173 acres (1%) of BLM-designated elk habitat in the project area would be replaced by well pads, roads, and evaporative facilities. Acres of disturbance in BLM-designated elk habitat would be approximately 6% greater under Alternative E than under the No Action Alternative, where acres of disturbance would be approximately 2,055 (see Table 4-141). In UDWR elk habitat, Alternative E would remove approximately 951 acres (2% of the total UDWR elk habitat in the project area) during construction of well pads, new roads, and evaporative facilities (see Table 4-142). This is more than 41% more habitat loss than under the No Action Alternative, where approximately 675 acres (0.6%) of surface disturbance would occur in UDWR elk habitat.

There would be 106 miles of new roads in BLM-designated elk habitat under Alternative E, approximately 49% more than under the No Action Alternative (see Table 4-143), and approximately 19% more than current conditions. In UDWR elk habitat, there would be 52 miles of new roads under Alternative E, approximately 2 times more than under the No Action Alternative (see Table 4-144), and approximately 20% more than current conditions.

4.16.1.5.1.3 Pronghorn Antelope

Approximately 2,174 acres (1%) of BLM-designated pronghorn antelope habitat in the project area would be impacted by well pads, roads, and evaporative facilities under Alternative E. Acres of disturbance in BLM-designated pronghorn antelope habitat would be approximately 6% greater under Alternative E than under the No Action Alternative, where acres of disturbance would be approximately 2,055 (see Table 4-141). In UDWR pronghorn antelope habitat, Alternative E would disturb approximately 1,346 acres (1.3% of the total UDWR pronghorn antelope habitat in the project area) during construction of well pads, new roads, and evaporative facilities (see Table 4-142). This is approximately 9% less habitat loss than under the No Action Alternative, where approximately 1,472 acres (1.4%) of surface disturbance would occur in UDWR pronghorn antelope habitat.

There would be 106 miles of new roads in BLM-designated pronghorn antelope habitat under Alternative E, approximately 49% more than under the No Action Alternative (see Table 4-143), and approximately 19% more than current conditions. In UDWR pronghorn antelope habitat, there would be 59 miles of new roads under Alternative E, approximately 23% more than under the No Action Alternative (see Table 4-144) and approximately 17% more than current conditions.

4.16.1.5.1.4 Rocky Mountain Bighorn Sheep

Under Alternative E, 667 acres (<1%) of BLM-designated bighorn sheep habitat in the project area would be impacted by well pads and roads. Acres of disturbance in BLM-designated bighorn sheep habitat would be just under 2 times greater under Alternative E than under the No Action Alternative, where acres of disturbance would be approximately 356 (see Table 4-141). In UDWR bighorn sheep habitat, Alternative E would remove approximately 242 acres (0.6% of the total UDWR bighorn sheep habitat in the project area) during construction of well pads and new roads (see Table 4-142). This is approximately 12% more habitat loss than under the No Action Alternative, where approximately 216 acres (0.6%) of surface disturbance would occur in UDWR bighorn sheep habitat.

There would be 36 miles of new roads in BLM-designated bighorn sheep habitat under Alternative E, more than 2 times the amount as under the No Action Alternative (see Table 4-143), and 21% more than current conditions. In UDWR bighorn sheep habitat, there would be 11 miles of new roads under Alternative E, approximately 38% more than under the No Action Alternative (see Table 4-144) and approximately 13% more than current conditions.

4.16.1.5.2 MOUNTAIN LION (COUGAR)

Assuming that the local mountain lion population is closely associated with the migratory mule deer herd, and that the lion population is currently stable, the magnitude of impacts to mountain lions under Alternative E would be the same as the magnitude of impacts to mule deer described above.

4.16.1.5.3 Upland Game

Under Alternative E, upland game would incur direct long-term adverse impacts from the loss of 2,175 acres (1%) of habitat and from disturbances associated with 106 miles (a 19% increase over current conditions) of new roads. Impacts would be greater under Alternative E than under the No Action Alternative because approximately 6% more habitat loss would occur and 49% more miles of new roads would be created under Alternative E than under the No Action Alternative (see Table 4-140).

4.16.1.5.4 Reptiles, Amphibians, and Other Non-game Species

Under Alternative E, impacts to reptiles and other non-game species would be the same as impacts to upland game (see Section 4.16.1.5.3).

Direct and indirect impacts to amphibians under Alternative E would be similar to the Proposed Action, except to a lesser degree. Direct and indirect impacts to amphibians under Alternative E would be increased compared to the No Action Alternative because more acres of disturbance would occur under Alternative E. (See Section 4.15, Water Resources, for a discussion of direct and indirect effects on water resources.)

4.16.1.5.5 Effects of Evaporative Facilities on Wildlife

Under Alternative E, 135 acres of evaporative facilities would be constructed. This is nearly 2.5 times more surface area for evaporative facilities than under the No Action Alternative (see Table 4-140). As described under the Proposed Action, effects on wildlife would be minimized due to compliance with BLM Onshore Order #7, the use of deterrents, and monitoring.

4.16.1.5.6 Effects of Habitat Fragmentation on Wildlife

4.16.1.5.6.1 Mule Deer

Approximately 164,795 acres (80%) of BLM-designated mule deer habitat in the project area would be unfavorable to mule deer due to existing and proposed roads under Alternative E. This is approximately 5% more unfavorable BLM-designated mule deer habitat than under the No Action Alternative (see Table 4-146), and 13% more than under current conditions. Approximately 57,208 acres (71%) of UDWR mule deer habitat in the project area would be unfavorable to mule deer due to existing and proposed roads under Alternative E. This is approximately 6% more unfavorable UDWR mule deer habitat than under the No Action Alternative, and 15% more than under current conditions (see Table 4-147).

4.16.1.5.6.2 Elk

Under Alternative E, approximately 141,413 acres (68%) of BLM-designated elk habitat in the project area would be unfavorable to elk due to existing and proposed roads. This is approximately 4% more unfavorable BLM-designated elk habitat than under the No Action Alternative (see Table 4-148), and 14% more than under current conditions. Approximately 69,168 acres (62%) of UDWR elk habitat in the project area would be unfavorable to elk due to existing and proposed roads under Alternative E. This is approximately 9% more unfavorable UDWR elk habitat than under the No Action Alternative, and 17% more than under current conditions (see Table 4-149).

4.16.1.5.6.3 Bighorn Sheep

Under current conditions, 100% of the BLM-designated and UDWR bighorn sheep habitat in the project area is unsuitably fragmented due to existing roads (see Table 4-150 and Table 4-151). Under Alternative E, all the BLM-designated and UDWR bighorn sheep habitat would continue to be unsuitably fragmented, as there would be no habitat patch sizes greater than 159 km^2. No habitat patch sizes greater than 159 km^2 would occur under the No Action Alternative either. However, the No Action Alternative would result in more than 2 times fewer miles of new roads (17 miles) in BLM-designated bighorn sheep habitat than under Alternative E, which would result in 36 miles of new roads (see Table 4-143). Likewise, in UDWR bighorn sheep habitat, the No Action Alternative would result in 38% fewer miles of new roads (8 miles) than under Alternative E, which would result in 11 miles of new roads.

4.16.1.6 ALTERNATIVE F: AGENCY PREFERRED ALTERNATIVE

Under Alternative F, 1,298 new natural gas wells would be drilled, requiring approximately 198 miles of new roads and 316 miles of new pipelines. Approximately 78 acres of evaporative facilities for produced groundwater would also be required. Total acres of disturbance under Alternative F would be approximately 3,604 acres. New natural gas wells under Alternative F represent a threefold increase in the project area compared to the No Action Alternative. Acres of evaporative facilities would increase by 2.5 times and total acres of disturbance would be approximately 1.6 times greater under Alternative F than under the No Action Alternative. Finally, there would be approximately 2.8 times more miles of new roads and just below 1.5 times more miles of new pipeline under Alternative F than under the No Action Alternative (see Table 4-140).

4.16.1.6.1 BIG GAME

4.16.1.6.1.1 Mule Deer

Approximately 3,600 acres of BLM-designated mule deer habitat would be lost due to natural gas development under Alternative F. This represents approximately 2% of the BLM-designated mule deer habitat in the project area. Acres of disturbance in BLM-designated mule deer habitat would be approximately 1.8 times greater under Alternative F than under the No Action Alternative, in which acres of disturbance would be approximately 2,054 (see Table 4-141). In UDWR mule deer habitat, Alternative F would disturb approximately 1,355 acres (2% of the total UDWR mule deer habitat in the project area) during construction of well pads, new roads, and evaporative facilities (see Table 4-142). This is more than 3 times the habitat loss than under the No Action Alternative, in which approximately 476 acres (0.6%) of surface disturbance would occur in UDWR mule deer habitat.

There would be 197 miles of new roads in BLM-designated mule deer habitat under Alternative F, approximately 2.5 times greater than under the No Action Alternative (see Table 4-143) and approximately 35% more than current conditions. In UDWR mule deer habitat, there would be 80 miles of new roads under Alternative F, nearly 4 times more than under the No Action Alternative (see Table 4-144) and approximately 42% more than current conditions. Under Alternative F, traffic volume in the project area is expected to increase by a maximum of 4.8%, compared to a maximum increase of 1.2% under the No Action Alternative (see Table 4-145). This estimated increase in traffic volume is the same for all big game and other species, and is not repeated in the sections below (see Section 4.5 for additional detail on traffic volume).

4.16.1.6.1.2 Elk

Under Alternative F, 3,600 acres of BLM-designated elk habitat would be disrupted by well pads, roads, and evaporative facilities. This represents approximately 2% of the total BLM-designated elk habitat in the project area. Acres of disturbance in BLM-designated elk habitat would be approximately 1.75 times greater under Alternative F than under the No Action Alternative, in which disturbances would impact approximately 2,055 acres (see Table 4-141). In UDWR elk habitat, Alternative F would remove approximately 1,846 acres (2%) of the total UDWR elk habitat in the project area) during construction of well pads, new roads, and evaporative facilities (see Table 4-142). This is more than 3 times more habitat loss than under the No Action Alternative, in which approximately 675 acres (0.6%) of surface disturbance would occur in UDWR elk habitat.

There would be 197 miles of new roads in BLM-designated elk habitat under Alternative F, approximately 3 times more than under the No Action Alternative (see Table 4-143) and approximately 35% more than current conditions. In UDWR elk habitat, there would be 112 miles of new roads under Alternative F, approximately 5 times greater than under the No Action Alternative (see Table 4-144) and approximately 43% more than current conditions.

4.16.1.6.1.3 Pronghorn Antelope

Approximately 3,600 acres of BLM-designated pronghorn antelope habitat would be converted to well pads, roads, and evaporative facilities under Alternative F. This represents approximately 2% of the total BLM-designated pronghorn antelope habitat in the project area. Acres of disturbance in BLM-designated pronghorn antelope habitat would be approximately 1.75 times greater under Alternative F than under the No Action Alternative, in which acres of disturbance would be approximately 2,055 (see Table 4-141). In UDWR pronghorn antelope habitat, Alternative F would remove approximately 1,901 acres (2% of the total UDWR pronghorn antelope habitat in the project area) during construction of well pads, new roads, and evaporative facilities (see Table 4-142). This is more than 25% more habitat loss than under the No Action Alternative, in which approximately 1,472 acres (1.4%) of surface disturbance would occur in UDWR pronghorn antelope habitat.

There would be 197 miles of new roads in BLM-designated pronghorn antelope habitat under Alternative F, approximately 3 times more than under the No Action Alternative (see Table 4-143) and approximately 35% more than current conditions. In UDWR pronghorn antelope habitat, there would be 95 miles of new roads under Alternative F, approximately twice than under the No Action Alternative (see Table 4-144) and approximately 28% more than current conditions.

4.16.1.6.1.4 Rocky Mountain Bighorn Sheep

Under Alternative F, 1,703 acres of BLM-designated bighorn sheep habitat would be disturbed by well pads and roads. This represents approximately 2% of bighorn sheep habitat in the project area. Acres of disturbance in BLM-designated bighorn sheep habitat would be 5 times greater under Alternative F than under the No Action Alternative, where acres of disturbance would be approximately 356 (see Table 4-141). In UDWR bighorn sheep habitat, Alternative F would remove approximately 571 acres (1% of the total UDWR bighorn sheep habitat in the project area) during construction of well pads and new roads (see Table 4-142). This is more than twice the habitat loss than under the No Action Alternative, where approximately 216 acres (0.6%) of surface disturbance would occur in UDWR bighorn sheep habitat.

There would be 101 miles of new roads in BLM-designated bighorn sheep habitat under Alternative F, nearly 6 times more than under the No Action Alternative (see Table 4-143) and 60% more than current conditions. In UDWR bighorn sheep habitat, there would be 34 miles of new roads under Alternative F, approximately 4.5 times greater than under the No Action Alternative (see Table 4-144) and approximately 41% more than current conditions.

4.16.1.6.2 Mountain Lion (Cougar)

Assuming that the local mountain lion population is closely associated with the migratory mule deer herd, and that the lion population is currently stable, the magnitude of impacts to mountain lions under Alternative F would be the same as the magnitude of impacts to mule deer as described above.

4.16.1.6.3 Upland Game

Under Alternative F, upland game would incur direct long-term adverse impacts from the loss of 3,602 acres (1.7%) of habitat and from disturbances associated with 198 miles (a 34% increase over current conditions) of new roads. Impacts would be greater under Alternative F than under the No Action Alternative, because approximately 3 times more habitat loss and miles of new roads would be created under Alternative F than under the No Action Alternative (see Table 4-140).

4.16.1.6.4 Reptiles, Amphibians, and Other Non-game Species

Under the Alternative F, impacts to reptiles and other non-game species would be the same as impacts to upland game (see Section 4.16.1.6.3).

No disturbance would occur in wetland/riparian areas under Alternative F, so there would be no direct impacts to amphibians. This is the same as under the No Action Alternative. Indirect impacts to amphibians under Alternative F would be similar to the Proposed Action. Indirect impacts to amphibians would be greater under Alternative F than under the No Action Alternative, because greater disturbance would occur under Alternative F. (See Section 4.15, Water Resources, for a discussion of direct and indirect effects on water resources.)

4.16.1.6.5 Effects of Evaporative Facilities on Wildlife

Under Alternative F, 78 acres of evaporative facilities would be constructed. This is approximately 1.5 times more surface area for evaporative facilities than under the No Action Alternative. As described under the Proposed Action, effects on wildlife would be minimized due to compliance with BLM Onshore Order #7, the use of deterrents, and monitoring (see Table 4-140).

4.16.1.6.6 Effects of Habitat Fragmentation on Wildlife

4.16.1.6.6.1 Mule Deer

Approximately 174,372 acres (84%) of BLM-designated mule deer habitat in the project area would be unfavorable to mule deer due to existing and proposed roads under Alternative F. This is approximately 8% more unfavorable BLM-designated mule deer habitat than under the No Action Alternative (see Table 4-146), and 14% more than under current conditions. Approximately 64,148 acres (79%) of UDWR mule deer habitat in the project area would be unfavorable to mule deer due to existing and proposed roads under Alternative F. This is approximately 19% more unfavorable UDWR mule deer habitat than under the No Action Alternative, and 29% more than under current conditions (see Table 4-147).

4.16.1.6.6.2 Elk

Under Alternative F, approximately 154,120 acres (75%) of BLM-designated elk habitat in the project area would be unfavorable to elk due to existing and proposed roads. This is approximately 13% more unfavorable BLM-designated elk habitat than under the No Action Alternative (see Table 4-148), and 24% more than under current conditions. Approximately 77,473 acres (70%) of UDWR elk habitat in the project area would be unfavorable to elk due to existing and proposed roads under Alternative F. This is approximately 22% more unfavorable UDWR elk habitat than under the No Action Alternative, and 32% more than under current conditions (see Table 4-149).

4.16.1.6.6.3 Bighorn Sheep

Under current conditions, 100% of the BLM-designated and UDWR bighorn sheep habitat in the project area is unsuitably fragmented due to existing roads (see Table 4-150 and Table 4-151). Under Alternative F, all of the BLM-designated and UDWR bighorn sheep habitat would continue to be unsuitably fragmented as there would be no habitat patch sizes greater than 159 km^2. No habitat patch sizes greater than 159 km^2 would occur under the No Action Alternative either. However, the No Action Alternative would result in nearly 6 times fewer miles of new roads (17 miles of new roads under the No Action Alternative) in BLM-designated bighorn sheep habitat than under Alternative F (101 miles of new roads under Alternative F) (see Table 4-143). Likewise, in UDWR bighorn sheep habitat the No Action Alternative would result in 4.5 times fewer miles of new roads (8 miles of new roads under the No Action Alternative) than under Alternative F (36 miles of new roads under Alternative F) (see Table 4-144).

4.16.2 Mitigation

In addition to applicant-committed measures (Section 2.1, Table 2-1), compliance with wildlife stipulations outlined in the Vernal RMP (BLM 2008c), and compliance with BLM Onshore Order #7, the following proposed measures could mitigate some impacts to wildlife in the project area:

- Wells and roads would be sited, whenever possible, within pinyon-juniper woodland-dominated habitat to reduce disturbance to mule deer foraging habitat.
- One acre of mitigation would be completed for every acre of disturbance within BLM-designated crucial mule deer winter range.

- Unnecessary roads and trails would be closed and reclaimed, as determined by the AO.
- All roads and well pads would be sited as far from permanent water sources as possible.
- Birds would be discouraged from evaporative facilities through the use of deterrents, as directed by the AO.
- All applicable Fluid Minerals BMPs from Appendix R of the Vernal RMP (BLM 2008c) would be implemented.
- Exploration, drilling, and other development activity would not be conducted within crucial elk calving and deer fawning habitat from May 15 to June 30.
- Activities that would result in adverse impacts to deer and elk within crucial winter range would be avoided from December 1 to April 30 unless deer and/or elk are not present or unless it is determined through analysis and coordination with UDWR that impacts could be mitigated.
- Within crucial deer winter range, no more than 10% of such habitat would be subject to surface disturbance and remain un-reclaimed at any given time.

4.16.3 Unavoidable Adverse Impacts

Of the adverse impacts described above, the following impacts would be unavoidable:

- Long-term losses of habitat for big game, birds, and other wildlife
- Fragmentation of wildlife habitat by roads, including reduction in size of contiguous roadless habitat areas
- Displacement of wildlife species during construction of roads, wells, pipelines, and ancillary features and during well drilling and completion

4.16.4 Irretrievable and Irreversible Commitments of Resources

Any losses of potential habitat useful for the survival of wildlife species would be irretrievable until disturbed areas were actively and adequately restored. The fragmentation of wildlife habitat would be irretrievable until these features were removed and reclaimed following project completion. Wildlife mortality due to project activities would be an irreversible impact. Any contamination of wildlife or wildlife habitat would be irretrievable until remediated.

4.16.5 Relationship of Short-term Uses to Long-term Productivity

Construction of roads, well pads, pipelines, and evaporative facilities would provide a short-term use that would result in long-term loss and fragmentation of wildlife habitat. Indirect effects resulting from increased access for OHVs, and legal and illegal hunting, would also have long-term negative impacts on the habitat suitability and productivity of wildlife species in the project area. These impacts would decrease the long-term productivity of the wildlife habitat in the project area, but would not eliminate it.

4.17 Wilderness Characteristics

The Vernal ROD (2008) does not carry the Desolation Canyon non-WSA lands with wilderness characteristics forward as a BLM natural area for the protection, preservation, or maintenance of wilderness characteristics. The analysis in the Vernal RMP (2008c) portrays this area as 66% leased, and under the Proposed RMP, sights and sounds of development would result in a direct loss of natural characteristics and reduction in quality of the outstanding opportunities for solitude and primitive and unconfined recreation. The RMP analysis shows that 72% of the wilderness characteristics area would be affected over the life of the plan by oil and gas development. A full analysis of impacts to this area and other wilderness characteristics areas in the Vernal FO is contained in the Vernal RMP. As a result, the Vernal ROD allows the Desolation Canyon non-WSA lands with wilderness characteristics to be subject to other management decisions that allow for degradation or loss of the wilderness characteristics values. Alternative-specific impacts from this project are included below.

4.17.1 Direct and Indirect Effects

4.17.1.1 Alternative A: Proposed Action Alternative

Under the Proposed Action approximately 1,491 wells would be drilled in the project area, approximately 222 of which would be within the Desolation Canyon non-WSA lands with wilderness characteristics. This would directly disturb 1,183 acres of the non-WSA lands in the project area (3% of the area). Wilderness characteristics (naturalness, solitude, and outstanding primitive recreation opportunities) would be forgone on that acreage due to surface disturbance and ongoing activities throughout the life of the project.

When analyzing the amount of non-WSA land acres with wilderness characteristics segmented to fewer than 5,000 acres by the project, approximately 6,405 acres of the Desolation Canyon non-WSA lands with wilderness characteristics would be affected (16% of the area), resulting in the following:

- Loss of remoteness and sense of solitude due to minerals-development related noise, potential vehicle presence, and potential views of well-drilling activities
- Loss of outstanding opportunities for primitive recreation

Impacts to wilderness characteristics would continue throughout the life of the project until reclamation is complete.

Compared to the No Action Alternative, this alternative would have more direct and indirect adverse impacts to wilderness characteristics. A comparison of direct and indirect impacts for each alternative is shown below in Table 4-152.

Table 4-152. Impacts to Non-WSA Lands with Wilderness Characteristics

Disturbances to Non-WSA Lands with Wilderness Characteristics (in acres)	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
From proposed wells	855	0	811	76	0	413
From pipelines and roads	328	22	437	42	21	196
Total direct surface disturbances	1,183	22	1,248	118	21	608
Total disturbances (from fragmentation of non-WSA lands with wilderness characteristics)	6,405	28	13,965	3,808	6	9,466
Percentage of non-WSA lands with wilderness characteristics (in project area) fragmented by project	16%	0.07%	35%	10%	0.02%	24.0%

4.17.1.2 Alternative B: Reduced Development

Under Alternative B none of the 1,114 developed wells would be constructed within the Desolation Canyon non-WSA lands with wilderness characteristics. However, the development of roads (to access wells in state lands located within the western half of the Desolation Canyon non-WSA lands with wilderness characteristics) and related gas and infrastructure would directly disturb 22 acres of non-WSA lands in the project area (0.05% of the area). Indirect impacts from the acres of non-WSA lands with wilderness characteristics segmented to fewer than 5,000 acres by the project would affect approximately 28 acres (0.07% of the area). Wilderness characteristics (naturalness, solitude, and primitive recreation opportunities) would be forgone on that acreage due to surface disturbance and ongoing activities throughout the life of the project. Alternative B would have fewer adverse impacts to wilderness values than the No Action Alternative, because a smaller total area would be affected by direct surface disturbances or by indirect impacts from noise and loss of opportunities for solitude and primitive recreational experiences. Impacts to wilderness characteristics would continue throughout the life of the project until reclamation is complete.

4.17.1.3 Alternative C: Full Development

Under Alternative C approximately 1,887 gas wells would be developed in the project area, of which 214 wells would be drilled within Desolation Canyon non-WSA lands with wilderness characteristics. Approximately 1,248 acres of non-WSA lands in the project area would be directly impacted by construction-related surface disturbances (3% of the area), with impacts similar to those discussed under the Proposed Action. The indirect impacts to non-WSA lands with wilderness characteristics would also be similar to those discussed under the Proposed Action, but to a greater degree, because 35% of the area (13,965 acres) would be indirectly affected by gas exploration and development through segmentation into parcels smaller than 5,000 acres. Wilderness characteristics (naturalness, solitude, and primitive recreation opportunities) would be forgone on that acreage due to surface disturbance and ongoing activities throughout the life of the project. Impacts to wilderness characteristics would continue throughout the life of the project until reclamation is complete.

4.17.1.4 Alternative D: No Action

Under the No Action Alternative, reasonably foreseeable, long-term development forecasts predict that approximately 368 wells would be drilled within the area, 20 of which would likely reside within Desolation Canyon non-WSA lands with wilderness characteristics. Some of these wells have already been drilled. This would potentially have direct surface-disturbance-related impacts on approximately 118 acres (0.3 % of non-WSA lands in the project area) from well pad, access road, and pipeline construction. Indirect impacts from acres of non-WSA lands with wilderness characteristics segmented to fewer than 5,000 acres by the project would be approximately 3,808 acres (10% of the Desolation Canyon non-WSA lands with wilderness characteristics). Impacts to wilderness characteristics would continue throughout the life of the project until reclamation is complete.

4.17.1.5 Alternative E: Reduced Development with Directional Drilling

Under Alternative E no new wells would be constructed within the Desolation Canyon non-WSA lands with wilderness characteristics. Direct surface disturbance would occur on approximately 21 acres of non-WSA lands in the project area (0.05% of the area) from pipeline and access routes construction. Indirect impacts from acres of non-WSA lands with wilderness characteristics segmented to fewer than 5,000 acres by the project would affect approximately 6 acres (0.02% of the area). Wilderness characteristics (naturalness, solitude, and primitive recreation opportunities) would be forgone on that acreage due to surface disturbance and ongoing activities throughout the life of the project. Impacts to wilderness characteristics would continue throughout the life of the project until reclamation is complete.

4.17.1.6 Alternative F: Agency Preferred Alternative

Under Alternative F approximately 1,298 wells would be drilled within the area, 215 of which would likely reside within Desolation Canyon non-WSA lands with wilderness characteristics. This would potentially have direct surface-disturbance-related impacts on approximately 608 acres (1.5% of non-WSA lands in the project area) from well pad, access road, and pipeline construction. Indirect impacts from acres of non-WSA lands with wilderness characteristics segmented to fewer than 5,000 acres by the project would be approximately 9,466 acres (24% of the Desolation Canyon non-WSA lands with wilderness characteristics). Impacts to wilderness characteristics would continue throughout the life of the project until reclamation is complete.

4.17.2 Mitigation

No additional mitigation is proposed to retain wilderness values, with the exception of visual resource mitigation to reduce the visual contrasts between surface disturbances, night-lighting, and visually intrusive structures (see Section 4.14, Visual Resources).

4.17.3 Unavoidable Adverse Impacts

Unavoidable, adverse impacts from the Proposed Action would include long-term reductions of roadless area and wilderness characteristics (naturalness and opportunities for solitude or primitive recreation). These losses would result from the fragmentation of roadless areas by new access roads for exploration and well production; from well pad, pipeline, and related infrastructure construction and maintenance; and from the presence, movement, and noise of gas-development vehicles and facilities. Wilderness values and activities are not compatible with surface disturbances, noise, and infrastructure construction.

4.17.4 Irretrievable and Irreversible Commitments of Resources

The proposed activities would have irretrievable impacts to non-WSA wilderness values because these values are incompatible with gas exploration and development. Wilderness values would be irretrievably lost until post-project surface disturbances were successfully reclaimed and the landscape was allowed to return to its natural, undeveloped state. The proposed activities would not have irreversible impacts on wilderness values because successful road and well-pad reclamation, vegetation re-growth, and ecological succession would eventually restore those values.

4.17.5 Relationship of Short-term Uses to Long-term Productivity

Construction of oil and gas facilities and infrastructures would provide a short-term mineral use that would eventually result in the long-term loss of non-WSA wilderness characteristics. Long-term impacts to wilderness characteristics would primarily be the result of infrastructure development, which would reduce the number of roadless areas, impair the naturalness of the areas' wilderness characteristics, and reduce opportunities for solitude and primitive recreation. All activities described are surface disturbing in nature, and would produce long-term impacts from short-term land uses. Impacts would persist until the infrastructure was removed and all surface disturbances were reclaimed.

4.18 Cumulative Impacts

4.18.1 Introduction

This section analyzes the cumulative impacts to specific resource values and uses that would occur from implementation of the Proposed Action and the other alternatives, in conjunction with other impacts from past, ongoing, and reasonably foreseeable future actions not associated with Alternative A (Proposed Action). In general, the geographic scope of the analysis is the area encompassed by the BLM's Vernal FO planning area, including all public lands, state lands, and private lands within that area. The Vernal FO planning area includes Daggett, Duchesne, and Uintah counties. In general, the Vernal FO planning area was used because it allows for the most appropriate and quantitative analysis of impacts that exist and would be affected cumulatively across the defined region. However, smaller geographic scopes of analysis are also included for several location-specific resources that are appropriately analyzed in discrete areas; these include livestock allotments, potential and designated ACECs, and proposed WSRs. In addition, cumulative impacts to recreation, transportation, and cultural resources within Nine Mile Canyon are analyzed, including areas of Nine Mile Canyon outside of the Vernal FO. A cumulative impacts analysis area (CIAA), indicating the area where incremental impacts or synergistic effects may occur and over which cumulative impacts are considered, is included for each resource. The timeframe of the analysis is the 45-year anticipated life of Gasco's proposed well field. However, the timeframe of cumulative impacts may vary from one resource value or use to another, depending on variations in the duration of different actions. Table 4-153 identifies the land use planning and environmental documents and data consulted in determining the pertinent existing and reasonably foreseeable future actions.

Table 4-153. Land Use Planning and Environmental Documents and Other Data Used for Cumulative Impacts Analysis

Planning/Environmental Document
Vernal FO ROD and Approved RMP, 2008
Revised MPR for the Vernal Planning Area, 2004
UDOGM 2010 existing well data
EOG Resources Inc., North Alger Natural Gas Expansion Project Draft Environmental Assessment, 2007, UT-080-06-099
XTO River Bend Unit Infill Environmental Assessment, 2008 UT-080-07-772
Enduring Resources Big Pack Environmental Assessment, 2008,UT-080-06-488
XTO Little Canyon Environmental Assessment, 2008, UT-080-05-249
EOG Greater Chapita Wells Natural Gas Infill Project EIS
Enduring Resources Southam Canyon Environmental Assessment, 2008, UT-080-08-342
Berry Petroleum ANF South Unit EIS
Programmatic EIS for Oil and Gas Development on Tribal Lands
Newfield Exploratory Development Area (EDA) #1 Environmental Assessment, 2010
Newfield Monument Butte EIS, 2011
Programmatic EIS for Uintah and Ouray Tribal Lands, 2010
XTO Hill Creek Environmental Assessment UT-010-09-329
Greater Natural Buttes Draft EIS, 2010, DES 10-31 (BLM 2010b)
Bill Barrett Corporation, West Tavaputs Draft EIS, 2008, UT-070-05-055
Oil Shale Research, Development and Demonstration Project, White River Mine, Uintah County, Utah, Environmental Assessment, 2007, UT-080-06-280

Although much of this analysis focuses on adverse cumulative impacts, it should be noted that cumulative impacts may also be beneficial. For example, there are positive cumulative economic effects of oil and gas development, including additional employment opportunities in the region, additional tax revenues to local governments, increased royalties to the federal government, and reduced dependence on foreign sources of energy. Section 4.18.2 (below) identifies the actions included in this cumulative analysis.

4.18.2 Past, Present, and Reasonably Foreseeable Future Actions and Development

This section of the EIS incorporates into the analysis key projects for past, ongoing, proposed, and potential actions that may result in incremental impacts or synergistic effects if implemented in combination with one of the alternatives considered in the EIS. For analysis purposes, reasonably foreseeable actions and development projections are defined as those based on existing decisions, funding, or formal proposals. The reasonably foreseeable actions and development projections identified below come from the Proposed Actions and Decisions from the plans and environmental analyses identified in Table 4-153 above. However, some of those plans, EISs, and environmental assessments (EAs) are not yet complete. Use of the Proposed Actions from Draft plans and Draft EISs/EAs does not intend to imply those actions are final decisions; rather, they are reasonably foreseeable assumptions for this cumulative impact analysis. Further, the projections are not to be considered part of the Proposed Action, or alternatives, in this proposal.

4.18.2.1 Geology and Minerals

4.18.2.1.1 Oil and Gas Exploration, Development, and Production

Oil and gas development is a major resource use in the project area and Vernal FO planning area. Development of oil and natural gas began in the early 1900s, and although historically cyclic, has been a continual public land use since that time. Currently, oil and gas production is experiencing a resurgence.

According to 2011 UDOGM data, there are 14,941 oil and gas wells in the Vernal FO planning area. The following surface disturbance assumptions, which are contained in the MPR for the Vernal Planning Area (BLM 2004b), have been applied to all past, present, and reasonably foreseeable oil and gas development:

- 2.4 acres surface disturbance per well
- 0.9 acres of surface disturbance per well will be reclaimed within one year after completion of operations
- Access road construction equals 0.20 mile per well (0.73 acres surface disturbance per well)
- 0.47 acres of surface disturbance for pipelines per well
- One third of pipeline surface disturbance will be reclaimed in the short term

Using the assumptions listed above, initial disturbance from roads, pipelines, and well pads in the Vernal planning area is estimated to be 3.6 acres per well. Long-term impacts (after reclamation) would be approximately 2.55 acres per well.

Table 4-154. Existing Oil and Gas Activity in the BLM Vernal FO

Well Status	Well Count (unit number)	Initial Disturbance (acres)	Long-term Disturbance (after reclamation) (acres)
Approved permit; not yet spudded	2,377	8,557	6,083
Spudded (drilling commenced); not yet completed	331	1,192	847
Gas Injection Well	2	7	5
Gas Storage Well	44	158	113
Drilling Operations Suspended	100	360	256
Plugged and abandoned	2,488	8,957	6,367
Producing Oil Well	4,573	16,463	11,702
Producing Gas Well	2,868	10,325	7,339
Returned permit; not approved	165	594	422
Shut-in Gas Well	541	1,948	1,384
Shut-in Gas Well	374	1,346	957
Temporarily Abandoned	99	356	253
Test Well	4	14	10
Water Disposal Well	52	187	133
Water Injection Well	919	3,308	2,352
Water Source Well	4	14	10
Total	**14,941**	**53,788**	**38,234**

Note: Well acreage numbers rounded to nearest whole number. These calculations do not include 3,021 wells for which the location was abandoned, well never drilled, and permit rescinded.

Based on UDOGM 2010 well data and using the assumptions above, long term impacts from past and present activity in the BLM Vernal FO planning area are estimated at approximately 38,324 acres (after reclamation). This total includes approximately 2,998 miles of access road. Of that total, 550 wells and 1,402 acres of surface disturbance (after reclamation and including 110 miles access road) are in the Gasco project area.

Table 4-155. contains information regarding the anticipated future acres of surface disturbance that would likely result from oil and gas production. This table includes oil and gas projects that were not foreseeable at the time the MPR was prepared and represents the best available information regarding reasonably foreseeable oil and gas projects within the BLM Vernal FO planning area.

Table 4-155. Reasonably Foreseeable Oil and Gas Projects within the BLM Vernal FO Planning Area

Project Name	Total within BLM Vernal FO				Inside the Gasco Project Area			
	Project Acreage	Wells (#)	Well Pads (#)	Disturb. (acres)	Fraction (%)	Wells (#)	Well Pads (#)	Disturb. (acres)
EOG North Alger EA	2,390	44	44	158	0	0	0	0
XTO River Bend Unit Infill EA	16,719	484	266	1,103	0	0	0	0
Enduring Resources Big Pack EA	34,437	664	292	1,620	0	0	0	0
XTO Little Canyon EA	32,241	510	362	1,882	0	0	0	0
BBC West Tavaputs Plateau EIS[1]	7,878	36	7	92	0.4%	2	1	5
EOG Greater Chapita Wells Natural Gas Infill Project EIS	42,018	7,028	1,679	5,688	0	0	0	0
Enduring Resources Southam Canyon EA	10,575	249	152	858	0	0	0	0
Berry Petroleum ANF South Unit EIS	25,608	400	162	825	0	0	0	0
Programmatic EIS for Uintah and Ouray Reservation Tribal Lands[2]	1,673,869	4,384	3,945	20,851	0.04%	2	1	8
Newfield MB EDA EA[3]	76,744	500	500	1,800	0.1%	≤1	≤1	1
Newfield Monument Butte EIS[4]	119,804	5,750	3,250	15,612	33%	1,918	1,084	5,207
XTO Hill Creek EA	5,417	137	101	287	0	0	0	0
Greater Natural Buttes Draft EIS	162,854	3,675	3,675	12,658	0	0	0	0
Total Pending Projects	**2,210,554**	**23,814**	**14,394**	**63,213**	**0**	**1,922**	**1,085**	**5,223**

Note: Informatlon In this table was compiled from various best available information regarding Proposed Action, preferred alternatives or selected alternatives. Sources included notices and NEPA documents for each project. Number of well pads includes development of new pad locations and expansion of existing pads. If number of pads was not stated, all were assumed to be drilled vertically (i.e., one well per pad). Where disturbance estimates were not available, total project-related disturbance using standard assumptions listed above, i.e., 3.6 acres per well

[1] 5.7% of the project is within the BLM Vernal FO. Totals for BLM Vernal FO and Gasco project area are based on a total project area of 137,932 acres (as calculated by GIS) and 626 wells, 120 well pads and 1,603 acres of initial surface disturbance (BLM 2010a, West Tavaputs ROD).

[2] 88.7% of the project area is within the Vernal FO. Totals for Vernal FO and Gasco project area are based on a total project area of 1,886,771 acres (as calculated by GIS) and 4,889 wells, 4,400 well pads, and 23,254 acres of surface disturbance.

[3] Assumed to be drilled vertically (i.e., one well per pad), initial disturbance estimated using standard assumptions listed above, i.e., 3.6 acres per well.

[4] Of the 5,750 total wells, up to 3,250 would be oil wells and 2,500 would be deep gas wells.

[5] RFD discrepancies between the Greater Natural Buttes air quality analysis and the Gasco Final EIS are due to the refinement in the cumulative emission inventories used in the Greater Natural Buttes analysis versus the Gasco analysis. The Gasco far-field analysis was performed in 2008, and utilized the modeling protocols and emission inventories that were developed in 2008. The cumulative emission inventory for the Gasco EIS was based on foreseeable development from known NEPA projects, and permitting information from the Utah and Colorado regulatory agencies that was current at the time the analysis was performed. The Greater Natural Buttes analysis was completed at a later date, and incorporated a larger number of known NEPA projects, as well as projections for sources based on the WRAP Phase III inventory. In short, the Gasco far-field analysis was based on the best available data at the time. Results from the *Greater Natural Buttes Supplement to the Draft EIS* (BLM 2011a) included the Gasco proposal as a reasonably foreseeable future development, and are incorporated into the Gasco FEIS analysis by reference.

In addition to the Proposed Action and its alternatives, reasonably foreseeable future oil and gas development projects within the general cumulative effects area would result in 23,814 wells and 63,213 acres of surface disturbance. Of this total, 1,922 wells and 5,223 acres of surface disturbance would be within the Gasco project area. Assuming 0.2 mile of access road per well, development of 23,814 wells would result in approximately 4,763 miles of road, 384 within the Gasco project area.

4.18.2.1.2 Other Leasable, Locatable, and Salable Minerals

The MPR for the Vernal Planning Area (BLM 2004b) projects development of tar sands, gilsonite, oil shale, phosphate, mineral materials (sand, gravel, building stone), locatable minerals (gold and uranium), and coal in the Vernal Planning Area over the next 15 years, as described below.

A high potential for some occurrence of tar sands exists in the southern portion of project area along the Carbon/Duchesne County line. The potential for development is low, other than for asphalt paving, but production cannot be predicted. Most of the known occurrence of gilsonite is located north and east of the Gasco project area. However, some veins do occur in the northeastern portion of the project area. The MPR projects 10 leases, but cannot predict the number of new mines that would be developed by lessees. Given the vast majority of gilsonite veins are outside the project area, it is difficult to predict any gilsonite development in the project area until better quality veins east of the project area are exhausted.

Substantial deposits of oil shale occur in the eastern and southern portions of the project area. Although the MPR does not predict significant oil shale development, it does anticipate one to 2 small-scale projects. Given the amount of the resource in the project area, a development could occur there. The potential for occurrence of phosphate is undetermined due to the lack of useful data. The nearest known resource is far north of the project area on the south slopes of the Uintah ountains. Exploration and production does not seem likely in the project area.

High potential for sand and gravel occurs in some areas of the west-central portion of the project area, and moderate demand is expected to continue. Although much of that demand would come from existing pits, industry inquiries into sales for mineral materials indicates the potential for at least 2 contract sales. It is possible one sale could occur in the project area. There is high potential for building stone in the southern part of the project area along the Carbon/Duchesne County line. In the next 15 years, there could be as many as 8 applications for sale of building stone to commercial vendors, and it is possible an operation would occur in the project area.

Most of the Gasco project area has moderate potential for placer gold or uranium. There is low potential for new mining claims as the geology is not well suited to economic development of locatable minerals. Thus, little development is anticipated due to regulatory requirements, low economic quality, and low quantity of deposits in the project area. Coal is not known to occur in the project area. Thus, it is unlikely that coal would be developed in the foreseeable future.

BLM land use plans provide for exploration and production of these resource values. Cumulative effects from non oil and gas mineral uses (oil shale, tar sands, locatable minerals, and salable minerals) are difficult to quantify, but are presumed to be of nominal impact in the project area (BLM 2005a).

4.18.2.2 Land Use and Transportation

The Vernal RMP proposes acquisition of easements to secure physical and legal access across state and private lands.

BLM estimates that there are currently approximately 14,374 miles of road in the BLM Vernal FO. There would be additional development of new roads associated with the reasonably foreseeable oil and gas development, as well as associated increases in traffic on both existing and new roads.

As part of the PA for the Final West Tavaputs EIS, the BLM may make changes to the on-going dust suppression efforts on Nine Mile Canyon Road. It is also reasonably foreseeable that certain segments of the road will be improved with hard surfacing, such as asphalt or chip and seal.

4.18.2.3 Livestock Management

The Vernal RMP includes provisions for the construction of between 812 guzzlers/reservoirs, 51 well/spring developments, 38 miles of pipeline, and 69 miles of fence to aid in livestock management, and ensure proper distribution of livestock and utilization of forage.

4.18.2.4 Recreation

The Vernal RMP includes management prescriptions to improve or construct up to 400 miles of trails for non-motorized recreation uses, including hiking, mountain biking, and horseback riding. For 400 miles of trail, surface disturbance would total 291 acres (assuming an average trail width of 6 feet). The RMP also plans to improve or construct up to 800 miles of motorized trails for backcountry recreational driving. For 800 miles of trail, surface disturbance would total approximately 1,148 acres (assuming an average trail width of 12 feet).

The Vernal RMP limits recreational OHV driving to 4,860 miles of existing routes on 1,643,475 acres of the public lands in the planning area. To meet other resource objectives, 75,845 acres (4% of the public lands) would be closed to all OHV travel. To provide for motorized recreation opportunities, cross-country travel would be permitted on 6,202 acres (<1% of the public lands).

4.18.2.5 Riparian

The Vernal RMP manages with the intent to limit livestock grazing use of key forage species to 30% in functioning riparian zones to maintain proper functioning condition of the riparian community. Grazing use would be limited to less than 20%, in riparian zones needing improvement, to achieve proper functioning condition of the riparian system.

4.18.2.6 Soils

To reduce and prevent soil erosion, the Vernal RMP requires an approved erosion control plan for surface disturbing activities on slopes between 21% and 40%, and prohibits surface disturbance on slopes greater than 40%.

4.18.2.7 Special Designations

The Vernal RMP continued designation of the Lower Green River ACEC to protect high value scenery and the riparian ecosystem. The ACEC is managed with prescriptions that include no surface occupancy for oil and gas development, VRM Class II objectives (retention of landscape character), and limits on OHV use to designated routes. The Vernal RMP continued designation of the Nine Mile Canyon ACEC to protect cultural resources. Oil and gas leases are issued with a no surface occupancy stipulation. The Vernal RMP continued designation of the Pariette Wetlands ACEC to protect special status bird and plant habitat and the wetlands ecosystem. Oil and gas leases are issued with a no surface occupancy stipulation. The Vernal RMP recommended the Lower Green River as suitable for Wild and Scenic River designation and manages WSAs to protect their values until Congress either designates them as wilderness or releases them for management of other values and uses.

4.18.2.8 Special Status Species

Under the Vernal RMP, human disturbances are prohibited within 0.25 mile year-round and within 2 miles of active greater sage-grouse leks during breeding season (March 1–June 15) to ensure successful reproduction. The RMP also restricts construction of permanent facilities or structures within 2 miles of a lek wherever possible. Further, the RMP mandates measures to reduce noise within 0.5 mile of leks, including multi-cylinder pumps, sound reducing mufflers, and placement of exhaust systems. The Vernal RMP also prohibits disturbance and occupancy with buffers around raptor nests, during breeding seasons, to ensure successful reproduction.

To minimize effects to federally threatened, endangered, or candidate plant species, the BLM, in coordination with the USFWS, has developed avoidance and minimization measures. Integration of and adherence to these measures will help ensure the activities carried out during oil and gas development (including but not limited to drilling, production, and maintenance) are in compliance with the ESA. The USFWS, in cooperation with the BLM, is developing a landscape-level, long-term monitoring program for the Sclerocactus species across their ranges in the Uinta Basin. The USFWS is currently working with the BLM on the identification of core conservation areas for federally listed plant species in the Uinta Basin.

4.18.2.9 Vegetation Treatments

Both the Vernal RMP and the Vernal Fire Management Plan (BLM 2009) prescribe as much as 156,425 acres of vegetation to be burned every decade to reduce fuel loading and threat of wildfire, maintain and restore vegetation communities, and maintain and enhance wildlife, livestock, and wild horse forage.

The Vernal RMP includes restoration and rehabilitation of up to 200,000 acres of sagebrush-steppe habitat over the life of the plan to achieve desired plant communities, to restore and enhance biological diversity, to maintain and enhance watershed condition and forage production, and to control noxious weeds. The treatments would be conducted using fire and biological, chemical, and mechanical methods.

The number of acres of each treatment cannot be added to determine a total acres treated (by any method), as there may be overlap of treatment areas and purposes.

4.18.2.10 WILDLIFE

Under the Vernal RMP, surface-disturbing activities are prohibited in deer migration corridors, seasonally. The RMP designates forage and habitat for Rocky Mountain bighorn sheep, including forage and habitat in Nine Mile Canyon. The RMP requires disturbances within crucial deer winter range to affect no more than 10% of such habitat at any given time.

4.18.3 CUMULATIVE IMPACTS RELATED TO THE PROPOSED ACTION AND ALTERNATIVES

4.18.3.1 AIR QUALITY

The cumulative air quality impact assessment evaluates emissions from project sources in addition to the emissions from existing permitted sources and emissions associated with reasonalbly foreseeable development (RFD) and reasonably foreseeable future actions (RFFA). Four pollutants, NO_x, SO_x, PM_{10}, and $PM_{2.5}$, were inventoried for the regional cumulative inventory. For the far-field analysis, the CIAA was defined as a grid covering an area of 412 km × 400 km (see Figure 4-1). A detailed discussion of cumulative emissions is provided in the Far-field Air Quality Technical Support Document (Appendix I).

RFD discrepancies between the Greater Natural Buttes analysis and the Gasco FEIS are due to the refinement in the cumulative emission inventories used in the Greater Natural Buttes analysis versus the Gasco analysis. The Gasco far-field analysis was performed in 2008, and utilized the modeling protocols and emission inventories that were developed in 2008. The cumulative emission inventory for the Gasco EIS was based on foreseeable development from known NEPA projects, and permitting information from the Utah and Colorado regulatory agencies that was current at the time the analysis was performed. The Greater Natural Buttes analysis was completed at a later date, and incorporated a larger number of known NEPA projects, as well as projections for sources based on the WRAP Phase III inventory. In short, the Gasco far-field analysis was based on the best available data at the time. The cumulative results results from the *Greater Natural Buttes Draft EIS* (BLM 2010b) are incorporated into the Gasco FEIS analysis.

4.18.3.1.1 FAR-FIELD CUMULATIVE AIR QUALITY

For the far-field cumulative impact analysis, emissions from each alternative were added to the emissions predicted for RFD, within an area defined as 412 × 400 km covering sections of eastern Utah and western Colorado. Impacts to air quality and AQRV were predicted for each of 15 areas of special concern and seven high elevation lakes shown in the tables in this section.

Table 4-156. Class I and Sensitive Class II PSD Areas

Sensitive Area	Federal Land Manager	PSD Designation
Arches NP	NPS	I
Black Canyon of the Gunnison WA	FS	I
Canyonlands NP	NPS	I
Capitol Reef NP	NPS	I
Flat Tops WA	FS	I
La Garita WA	FS	I
Maroon Bells-Snowmass WA	FS	I
Weminuche WA	FS	I
West Elk WA	FS	I
Colorado NM	NPS	II
Dinosaur NM	NPS	II
Flaming Gorge NRA	NPS	II
High Uintas WA	FS	II
Ouray NWR	FWS	II
Ragged WA	FS	II

Table 4-157. Sensitive Lakes

Location	Sensitive Lake
Flat Tops WA	Ned Wilson
Flat Tops WA	Upper Ned Wilson
High Uintas WA	Dean
High Uintas WA	Pine Island
Maroon Bells WA	Moon
Raggeds WA	Deep Creek #1
West Elk WA	S. Golden

4.18.3.1.2 Ambient Air Quality Standards

Significance criteria for potential criteria pollutant impacts include the NAAQS. Utah and Colorado have adopted the NAAQS as the standard for the State.

Predicted maximum cumulative pollutant concentrations that could occur as a result of the implementation each alternative in conjunction with cumulative sources are summarized in the following tables and compared with the NAAQS. The values indicate the maximum for the three years (2001, 2002 and 2003) of modeling. As demonstrated, increases in pollutant concentrations are predicted to occur at levels below the NAAQS.

Additionally, the results from the cumulative analysis performed for the *Greater Natural Buttes Supplement to the Draft EIS* (BLM 2011a) and incorporated by reference show that all cumulative impacts from all sources for each of the alternatives analyzed in the *Greater Natural Buttes Supplement to the Draft EIS*, including the modeled non-project sources, were below the established NAAQS at Class I and Class II areas for all criteria pollutants.

Table 4-158. Cumulative with Alternative A (Proposed Action) Maximum Pollutant Concentrations for Modeled Years (2001–2003) at Class I Areas (micrograms per cubic meter)

Pollutant	Averaging Period	PSD Class I Increment ($\mu g/m^3$)	Arches NP	Black Canyon of the Gunnison WA	Canyonlands NP	Capitol Reef NP	Flat Tops WA	La Garita WA	Maroon Bells-Snowmass WA	Weminuche WA	West Elk WA
$PM_{2.5}$	24-hour	N/A	0.177	0.13	0.28	0.191	0.13	0.053	0.171	0.041	0.092
	Annual	N/A	0.02	8.25×10^{-03}	0.11	3.35×10^{-03}	0.02	2.50×10^{-03}	0.02	2.05×10^{-03}	7.65×10^{-03}
PM_{10}	24-hour	8	1.41	0.99	2.25	1.49	0.99	0.39	1.07	0.30	0.67
NO_2	Annual	2.5	0.16	0.064	0.045	7.30×10^{-03}	0.11	3.79×10^{-03}	0.05	2.66×10^{-03}	0.02
SO_2	3-hour	25	0.50	0.12	0.56	0.57	0.42	0.08	0.16	0.08	0.14
	24-hour	5	0.19	0.04	0.23	0.21	0.09	0.03	0.04	0.03	0.03
	Annual	2	0.02	3.68×10^{-03}	0.02	6.76×10^{-03}	8.96×10^{-03}	1.30×10^{-03}	3.89×10^{-03}	1.22×10^{-03}	2.83×10^{-03}

Table 4-159. Cumulative with Alternative B Maximum Pollutant Concentrations for Modeled Years (2001–2003) at Class I Areas (micrograms per cubic meter)

Pollutant	Averaging Period	PSD Class I Increment ($\mu g/m^3$)	Arches NP	Black Canyon of the Gunnison WA	Canyonlands NP	Capitol Reef NP	Flat Tops WA	La Garita WA	Maroon Bells-Snowmass WA	Weminuche WA	West Elk WA
$PM_{2.5}$	24-hour	N/A	0.14	0.09	0.18	0.14	0.13	0.037	0.1712	0.035	0.0708
	Annual	N/A	0.02	6.49×10^{-03}	8.29×10^{-03}	2.33×10^{-03}	0.02	1.97×10^{-03}	0.01	1.70×10^{-03}	6.45×10^{-03}
PM_{10}	24-hour	8	0.89	0.58	1.21	0.55	0.75	0.23	1.06	0.24	0.44
NO_2	Annual	2.5	0.114	0.06	0.04	7.04×10^{-03}	0.11	3.74×10^{-03}	0.05	2.62×10^{-03}	0.02
SO_2	3-hour	25	0.496	0.12	0.560	0.57	0.42	0.08	0.16	0.08	0.14
	24-hour	5	0.19	0.05	0.23	0.21	0.09	0.02	0.04	0.03	0.03
	Annual	2	0.02	0.00	0.02	0.01	0.01	0.00	3.88×10^{-03}	1.22×10^{-03}	2.82×10^{-03}

Table 4-160. Cumulative with Alternative C Maximum Pollutant Concentrations for Modeled Years (2001–2003) at Class I Areas (micrograms per cubic meter)

Pollutant	Averaging Period	PSD Class I Increment (µg/m^3)	Arches NP	Black Canyon of the Gunnison WA	Canyonlands NP	Capitol Reef NP	Flat Tops WA	La Garita WA	Maroon Bells-Snowmass WA	Weminuche WA	West Elk WA
$PM_{2.5}$	24-hour	N/A	0.193	0.14	0.31	0.207	0.14	0.056	0.172	0.043	0.097
	Annual	N/A	0.02	8.64×10^{-03}	0.01	3.58×10^{-03}	0.02	2.63×10^{-03}	0.02	0.04	7.97×10^{-03}
PM_{10}	24-hour	8	1.57	1.08	2.47	1.65	1.10	0.42	1.07	0.32	0.73
NO_2	Annual	2.5	0.12	0.06	0.05	7.44×10^{-03}	0.11	3.81×10^{-03}	0.05	2.68×10^{-03}	0.02
SO_2	3-hour	25	0.50	0.12	0.56	0.57	0.42	0.08	0.16	0.08	0.10
	24-hour	5	0.19	0.05	0.23	0.21	0.09	0.02	0.04	0.03	0.03
	Annual	2	0.02	3.68×10^{-03}	0.02	6.76×10^{-03}	8.97×10^{-03}	1.30×10^{-03}	3.89×10^{-03}	0.04	2.83×10^{-03}

Table 4-161. Cumulative with Alternative D (No Action) Maximum Pollutant Concentrations for Modeled Years (2001–2003) at Class I Areas (micrograms per cubic meter)

Pollutant	Averaging Period	PSD Class I Increment ($\mu g/m^3$)	Arches NP	Black Canyon of the Gunnison WA	Canyonlands NP	Capitol Reef NP	Flat Tops WA	La Garita WA	Maroon Bells-Snowmass WA	Weminuche WA	West Elk WA
$PM_{2.5}$	24-hour	N/A	0.11	0.08	0.16	0.11	0.12	0.03	0.17	0.03	0.07
	Annual	N/A	0.01	6.06×10^{-03}	7.08×10^{-03}	2.02×10^{-03}	0.02	1.75×10^{-03}	0.01	1.45×10^{-03}	5.90×10^{-03}
PM_{10}	24-hour	8	0.49	0.40	0.82	0.51	0.59	0.16	0.89	0.17	0.33
NO_2	Annual	2.5	0.11	0.06	0.04	6.55×10^{-03}	0.11	3.66×10^{-03}	0.05	2.54×10^{-03}	0.02
SO_2	3-hour	25	0.50	0.12	0.56	0.57	0.42	0.08	0.16	0.08	0.14
	24-hour	5	0.20	0.05	0.23	0.21	0.09	0.02	0.04	0.03	0.03
	Annual	2	0.02	3.65×10^{-03}	0.02	6.74×10^{-03}	8.92×10^{-03}	1.29×10^{-03}	3.87×10^{-03}	1.21×10^{-03}	2.81×10^{-03}

Table 4-162. Cumulative with Alternative E Maximum Pollutant Concentrations for Modeled Years (2001–2003) at Class I Areas (micrograms per cubic meter)

Pollutant	Averaging Period	PSD Class I Increment (µg/m³)	Arches NP	Black Canyon of the Gunnison WA	Canyonlands NP	Capitol Reef NP	Flat Tops WA	La Garita WA	Maroon Bells-Snowmass WA	Weminuche WA	West Elk WA
$PM_{2.5}$	24-hour	N/A	0.16	0.12	0.26	0.18	0.13	0.049	0.1714	0.039	0.5313
	Annual	N/A	0.02	7.86×10^{-03}	0.01	3.12×10^{-03}	0.02	2.36×10^{-03}	0.01	1.94×10^{-03}	7.34×10^{-03}
PM_{10}	24-hour	8	1.24	0.89	2.01	1.33	0.87	0.35	1.07	0.28	1.06
NO_2	Annual	2.5	0.117	0.06	0.05	7.48×10^{-03}	0.11	3.82×10^{-03}	0.05	2.69×10^{-03}	0.02
SO_2	3-hour	25	0.496	0.12	0.561	0.57	0.42	0.08	0.16	0.08	0.14
	24-hour	5	0.19	0.05	0.23	0.21	0.09	0.02	0.04	0.03	0.03
	Annual	2	0.02	3.69×10^{-03}	0.02	6.76×10^{-03}	$8.99 \times 10\text{-}0^{3}$	1.30×10^{-03}	3.90×10^{-03}	1.22×10^{-03}	2.84×10^{-03}

Table 4-163. Cumulative with Alternative F[1] Maximum Pollutant Concentrations for Modeled Years (2001–2003) at Class I Areas (micrograms per cubic meter)

Pollutant	Averaging Period	PSD Class I Increment ($\mu g/m^3$)	Arches NP	Black Canyon of the Gunnison WA	Canyonlands NP	Capitol Reef NP	Flat Tops WA	La Garita WA	Maroon Bells-Snowmass WA	Weminuche WA	West Elk WA
$PM_{2.5}$	24-hour [1]	N/A	0.177	0.13	0.28	0.191	0.13	0.053	0.171	0.041	0.092
	Annual	N/A	0.02	8.25×10^{-03}	0.11	3.35×10^{-03}	0.02	2.50×10^{-03}	0.02	2.05×10^{-03}	7.65×10^{-03}
PM_{10}	24-hour	8	1.41	0.99	2.25	1.49	0.99	0.39	1.07	0.30	0.67
NO_2	Annual	2.5	0.16	0.064	0.045	7.30×10^{-03}	0.11	3.79×10^{-03}	0.05	2.66×10^{-03}	0.02
SO_2	3-hour	25	0.50	0.12	0.56	0.57	0.42	0.08	0.16	0.08	0.14
	24-hour	5	0.19	0.04	0.23	0.21	0.09	0.03	0.04	0.03	0.03
	Annual	2	0.02	3.68×10^{-03}	0.02	6.76×10^{-03}	8.96×10^{-03}	1.30×10^{-03}	3.89×10^{-03}	1.22×10^{-03}	2.83×10^{-03}

[1] Impacts assumed to be equal to or less than Alternative A

Table 4-164. Cumulative with Alternative B Maximum Pollutant Concentrations for Modeled Years (2001–2003) at Class II Areas (micrograms per cubic meter)

Pollutant	Averaging Period	PSD Class II Increment (μg/m³)	NAAQS (μg/m³)	Dinosaur NM	Colorado NM	Flaming Gorge NRA	Ouray NWR	Ragged WA	High Uintas WA
$PM_{2.5}$	24-hour	N/A	35	1.71	0.16	0.25	5.96	0.17	0.33
	Annual	N/A	15	0.22	0.02	0.02	1.71	0.01	0.02
PM_{10}	24-hour	30	150	9.7	0.83	1.48	32.9	0.89	2.03
NO_2	Annual	25	100	0.99	0.07	0.23	8.87	0.03	0.05
SO_2	3-hour	512	1300	2.06	3.05	0.26	140	0.13	0.50
	24-hour	91	365	0.32	0.46	0.14	76.1	0.03	0.15
	Annual	20	80	0.03	0.03	9.22×10^{-03}	12.1	3.27×10^{-03}	0.01

Table 4-165. Cumulative with Alternative C Maximum Pollutant Concentrations for Modeled Years (2001–2003) at Class II Areas (micrograms per cubic meter)

Pollutant	Averaging Period	PSD Class II Increment (µg/m^3)	NAAQS (µg/m^3)	Dinosaur NM	Colorado NM	Flaming Gorge NRA	Ouray NWR	Ragged WA	High Uintas WA
$PM_{2.5}$	24-hour	N/A	35	0.25	2.04	0.26	8.24	0.17	0.64
	Annual	N/A	15	0.02	0.29	0.04	1.89	0.01	0.03
PM_{10}	24-hour	30	150	2.00	15.15	2.98	64.1	1.07	5.76
NO_2	Annual	25	100	0.07	1.02	0.24	8.94	0.03	0.05
SO_2	3-hour	512	1300	3.05	2.06	0.26	0.58	0.13	0.5
	24-hour	91	365	0.46	0.32	0.14	0.32	0.03	0.15
	Annual	20	80	0.03	0.03	9.33×10^{-03}	0.32	3.29×10^{-03}	0.01

Table 4-166. Cumulative with Alternative D (No Action) Maximum Pollutant Concentrations for Modeled Years (2001–2003) at Class II Areas (micrograms per cubic meter)

Pollutant	Averaging Period	PSD Class II Increment (μg/m^3)	NAAQS (μg/m^3)	Dinosaur NM	Colorado NM	Flaming Gorge NRA	Ouray NWR	Ragged WA	High Uintas WA
$PM_{2.5}$	24-hour	N/A	35	1.65	0.16	0.23	5.59	0.17	0.28
	Annual	N/A	15	0.21	0.02	0.02	1.68	0.01	0.01
PM_{10}	24-hour	30	150	9.15	0.77	1.26	29.2	0.89	1.53
NO_2	Annual	25	100	0.94	0.07	0.23	8.72	0.03	0.05
SO_2	3-hour	512	1300	2.06	3.05	0.26	0.58	0.13	0.50
	24-hour	91	365	0.32	0.46	0.13	0.31	0.03	0.15
	Annual	20	80	0.03	0.03	9.13×10^{-03}	0.11	3.26×10^{-03}	0.01

Table 4-167. Cumulative with Alternative E Maximum Pollutant Concentrations for Modeled Years (2001–2003) at Class II Areas (micrograms per cubic meter)

Pollutant	Averaging Period	PSD Class II Increment (μg/m^3)	NAAQS (μg/m^3)	Dinosaur NM	Colorado NM	Flaming Gorge NRA	Ouray NWR	Ragged WA	High Uintas WA
$PM_{2.5}$	24-hour	N/A	35	0.22	1.92	0.33	7.42	0.17	0.53
	Annual	N/A	15	0.02	0.26	0.031	1.82	0.01	0.025
PM_{10}	24-hour	30	150	1.64	13.82	2.60	55.1	1.06	4.52
NO_2	Annual	25	100	0.07	1.02	0.236	8.95	0.03	0.055
SO_2	3-hour	512	1300	3.05	2.06	0.26	0.64	0.13	0.5
	24-hour	91	365	0.46	0.32	0.14	0.34	0.03	0.15
	Annual	20	80	0.03	0.03	9.39×10^{-03}	0.11	3.29×10^{-03}	0.01

Table 4-168. Cumulative with Alternative F[1] Maximum Pollutant Concentrations for Modeled Years (2001–2003) at Class II Areas (micrograms per cubic meter)

Pollutant	Averaging Period	PSD Class II Increment (µg/m^3)	NAAQS (µg/m^3)	Dinosaur NM	Colorado NM	Flaming Gorge NRA	Ouray NWR	Ragged WA	High Uintas WA
$PM_{2.5}$	24-hour[1]	N/A	35	01.98	0.23	1.98	0.35	7.82	0.17
	Annual	N/A	15	0.28	0.02	0.28	0.03	1.86	0.01
PM_{10}	24-hour	30	150	14.50	1.83	14.50	2.86	59.7	1.06
NO_2	Annual	25	100	1.01	0.07	1.01	0.23	8.93	0.03
SO_2	3-hour	512	1,300	2.06	3.05	2.06	0.26	0.59	0.13
	24-hour	91	365	0.32	0.46	0.32	0.13	0.33	0.03
	Annual	20	80	0.03	0.03	0.03	9.29×10^{-03}	0.11	3.28×10^{-03}

[1] Impacts assumed to be equal to or less than Alternative A

4.18.3.1.3 TERRESTRIAL ACID DEPOSITION

Terrestrial deposition impacts were predicted for dry and wet nitrogen and sulfur chemical species and were compared to the FLAG deposition analysis thresholds (DAT) for Class 1 areas of 0.005 kg/ha/yr (FLAG 2010). The following tables present the cumulative deposition results. Project-related impacts are presented in Section 4.2.2.3.

Table 4-169. Cumulative with Alternative A (Proposed Action) Nitrogen and Sulfur Deposition Maximum Predicted Potential Impacts from 2001–2003

Area of Special Concern (Class I Areas)	Max N Dep (kg/ha/yr)	Max S Dep (kg/ha/yr)	Area of Special Concern (Class II Areas)	Max N Dep (kg/ha/yr)	Max S Dep (kg/ha/yr)
Arches NP	1.99×10^{-02}	6.02×10^{-03}	Dinosaur NM	1.97×10^{-01}	1.35×10^{-02}
Black Canyon of the Gunnison WA	2.18×10^{-02}	2.93×10^{-03}	Colorado NM	2.51×10^{-02}	1.18×10^{-02}
Canyonlands NP	1.12×10^{-02}	5.44×10^{-03}	Flaming Gorge NRA	8.45×10^{-02}	6.22×10^{-03}
Capitol Reef NP	5.19×10^{-03}	2.51×10^{-03}	Ouray NWR	8.42×10^{-01}	2.14×10^{-02}
Flat Tops WA	5.02×10^{-02}	6.81×10^{-03}	Ragged WA	1.67×10^{-02}	2.90×10^{-03}
La Garita WA	4.78×10^{-03}	1.29×10^{-03}	High Uintas WA	1.85×10^{-02}	8.25×10^{-03}
Maroon Bells-Snowmass WA	$2.12 \times 10\text{-}^{02}$	3.32×10^{-03}			
Weminuche WA	4.21×10^{-03}	1.27×10^{-03}			
West Elk WA	1.23×10^{-02}	2.61×10^{-03}			

NP = National Park
WA = Wilderness Area
NM = National Monument
NWR = National Wildlife Refuge
NRA = National Recreation Area

Table 4-170. Cumulative with Alternative B Nitrogen and Sulfur Deposition Maximum Predicted Potential Impacts from 2001–2003

Area of Special Concern (Class I Areas)	Max N Dep (kg/ha/yr)	Max S Dep (kg/ha/yr)	Area of Special Concern (Class II Areas)	Max N Dep (kg/ha/yr)	Max S Dep (kg/ha/yr)
Arches NP	1.95×10^{-02}	6.01×10^{-03}	Dinosaur NM	1.93×10^{-01}	1.34×10^{-02}
Black Canyon of the Gunnison WA	2.16×10^{-02}	2.92×10^{-03}	Colorado NM	2.45×10^{-02}	1.18×10^{-02}
Canyonlands NP	1.10×10^{-02}	5.43×10^{-03}	Flaming Gorge NRA	8.37×10^{-02}	6.19×10^{-03}
Capitol Reef NP	5.05×10^{-03}	2.51×10^{-03}	Ouray NWR	8.35×10^{-01}	2.13×10^{-02}
Flat Tops WA	4.98×10^{-02}	6.79×10^{-03}	Ragged WA	1.66×10^{-02}	2.90×10^{-03}
La Garita WA	4.70×10^{-03}	1.29×10^{-03}	High Uintas WA	1.80×10^{-02}	8.24×10^{-03}
Maroon Bells-Snowmass WA	2.10×10^{-02}	3.31×10^{-03}			
Weminuche WA	4.13×10^{-03}	1.27×10^{-03}			
West Elk WA	1.22×10^{-02}	2.61×10^{-03}			

NP = National Park
WA = Wilderness Area
NM = National Monument
NWR = National Wildlife Refuge
NRA = National Recreation Area

Table 4-171. Cumulative with Alternative C Nitrogen and Sulfur Deposition Maximum Predicted Potential Impacts from 2001–2003

Area of Special Concern (Class I Areas)	Max N Dep (kg/ha/yr)	Max S Dep (kg/ha/yr)	Area of Special Concern (Class II Areas)	Max N Dep (kg/ha/yr)	Max S Dep (kg/ha/yr)
Arches NP	2.02×10^{-02}	6.08×10^{-03}	Dinosaur NM	2.00×10^{-01}	1.36×10^{-02}
Black Canyon of the Gunnison WA	2.19×10^{-02}	2.96×10^{-03}	Colorado NM	2.55×10^{-02}	1.19×10^{-02}
Canyonlands NP	1.14×10^{-02}	5.46×10^{-03}	Flaming Gorge NRA	8.52×10^{-02}	6.32×10^{-03}
Capitol Reef NP	5.29×10^{-03}	2.52×10^{-03}	Ouray NWR	8.45×10^{-01}	2.22×10^{-02}
Flat Tops WA	5.05×10^{-02}	6.89×10^{-03}	Ragged WA	1.69×10^{-02}	2.94×10^{-03}
La Garita WA	4.83×10^{-03}	1.31×10^{-03}	High Uintas WA	1.89×10^{-02}	8.27×10^{-03}
Maroon Bells-Snowmass WA	2.13×10^{-02}	3.35×10^{-03}			
Weminuche WA	4.27×10^{-03}	1.29×10^{-03}			
West Elk WA	1.24×10^{-02}	2.64×10^{-03}			

NP = National Park
WA = Wilderness Area
NM = National Monument
NWR = National Wildlife Refuge
NRA = National Recreation Area

Table 4-172. Cumulative with Alternative D (No Action) Nitrogen and Sulfur Deposition Maximum Predicted Potential Impacts from 2001–2003

Area of Special Concern (Class I Areas)	Max N Dep (kg/ha/yr)	Max S Dep (kg/ha/yr)	Area of Special Concern (Class II Areas)	Max N Dep (kg/ha/yr)	Max S Dep (kg/ha/yr)
Arches NP	1.88×10^{-02}	5.99×10^{-03}	Dinosaur NM	1.85×10^{-01}	1.34×10^{-02}
Black Canyon of the Gunnison WA	2.13×10^{-02}	2.92×10^{-03}	Colorado NM	2.36×10^{-02}	1.18×10^{-02}
Canyonlands NP	1.07×10^{-02}	5.42×10^{-03}	Flaming Gorge NRA	8.23×10^{-02}	6.16×10^{-03}
Capitol Reef NP	4.81×10^{-03}	2.51×10^{-03}	Ouray NWR	8.17×10^{-01}	2.09×10^{-02}
Flat Tops WA	4.91×10^{-02}	6.77×10^{-03}	Ragged WA	1.63×10^{-02}	2.89×10^{-03}
La Garita WA	4.56×10^{-03}	1.29×10^{-03}	High Uintas WA	1.70×10^{-02}	8.24×10^{-03}
Maroon Bells-Snowmass WA	2.07×10^{-02}	3.30×10^{-03}			
Weminuche WA	3.99×10^{-03}	1.27×10^{-03}			
West Elk WA	1.19×10^{-02}	2.60×10^{-03}			

NP = National Park
WA = Wilderness Area
NM = National Monument
NWR = National Wildlife Refuge
NRA = National Recreation Area

Table 4-173. Cumulative with Alternative E Nitrogen and Sulfur Deposition Maximum Predicted Potential Impacts from 2001–2003

Area of Special Concern (Class I Areas)	Max N Dep (kg/ha/yr)	Max S Dep (kg/ha/yr)	Area of Special Concern (Class II Areas)	Max N Dep (kg/ha/yr)	Max S Dep (kg/ha/yr)
Arches NP	1.90×10^{-02}	6.04×10^{-03}	Dinosaur NM	1.85×10^{-01}	1.34×10^{-02}
Black Canyon of the Gunnison WA	2.13×10^{-02}	2.94×10^{-03}	Colorado NM	2.37×10^{-02}	1.18×10^{-02}
Canyonlands NP	1.07×10^{-02}	5.43×10^{-03}	Flaming Gorge NRA	8.25×10^{-02}	6.19×10^{-03}
Capitol Reef NP	4.84×10^{-03}	2.52×10^{-03}	Ouray NWR	8.21×10^{-01}	2.16×10^{-02}
Flat Tops WA	4.92×10^{-02}	6.83×10^{-03}	Ragged WA	1.63×10^{-02}	2.91×10^{-03}
La Garita WA	4.59×10^{-03}	1.30×10^{-03}	High Uintas WA	1.72×10^{-02}	8.24×10^{-03}
Maroon Bells-Snowmass WA	2.07×10^{-02}	3.33×10^{-03}			
Weminuche WA	4.02×10^{-03}	1.28×10^{-03}			
West Elk WA	1.19×10^{-02}	2.62×10^{-03}			

NP = National Park NM = National Monument NRA = National Recreation Area
WA = Wilderness Area NWR = National Wildlife Refuge

Table 4-174. Cumulative with Alternative F[1] Nitrogen and Sulfur Deposition Maximum Predicted Potential Impacts from 2001–2003

Area of Special Concern (Class I Areas)	Max N Dep (kg/ha/yr)	Max S Dep (kg/ha/yr)	Area of Special Concern (Class II Areas)	Max N Dep (kg/ha/yr)
Arches NP	$1.99 \times 10\text{-}^{02}$	6.02×10^{-03}	Dinosaur NM	$1.97 \times 10\text{-}^{01}$
Black Canyon of the Gunnison WA	$2.18 \times 10\text{-}^{02}$	2.93×10^{-03}	Colorado NM	$2.51 \times 10\text{-}^{02}$
Canyonlands NP	$1.12 \times 10\text{-}^{02}$	5.44×10^{-03}	Flaming Gorge NRA	$8.45 \times 10\text{-}^{02}$
Capitol Reef NP	5.19×10^{-03}	2.51×10^{-03}	Ouray NWR	$8.42 \times 10\text{-}^{01}$
Flat Tops WA	$5.02 \times 10\text{-}^{02}$	6.81×10^{-03}	Ragged WA	$1.67 \times 10\text{-}^{02}$
La Garita WA	4.78×10^{-03}	1.29×10^{-03}	High Uintas WA	$1.85 \times 10\text{-}^{02}$
Maroon Bells-Snowmass WA	$2.12 \times 10\text{-}^{02}$	3.32×10^{-03}		
Weminuche WA	4.21×10^{-03}	1.27×10^{-03}		
West Elk WA	$1.23 \times 10\text{-}^{02}$	2.61×10^{-03}		

NP = National Park NM = National Monument NRA = National Recreation Area
WA = Wilderness Area NWR = National Wildlife Refuge
[1] Impacts assumed to be equal to or less than Alternative A.

4.18.3.1.4 Aquatic Acid Deposition

Potential acid neutralizing capacity (ANC) impacts were calculated manually by applying the screening methodology prescribed by the USFS. Predicted project impacts at all lakes are less than a 10% change in ANC as summarized in the following tables.

Table 4-175. Cumulative Nitrogen and Sulfur Deposition Maximum Predicted Potential Impacts from 2001–2003

Lake of Special Concern	Nitrogen (Dn) Deposition (kg/ha/yr)	Sulfur (Ds) Deposition (kg/ha/yr)	ANC Change (μeq/l)	Percent ANC Change
Alternative A				
Ned Wilson	3.49×10^{-02}	5.47×10^{-03}	1.21	2.08%
Upper Ned Wilson	3.49×10^{-02}	5.47×10^{-03}	1.33	6.26%
Moon	1.55×10^{-02}	2.81×10^{-03}	13.7	0.80%
Deep Creek 1	1.40×10^{-02}	2.66×10^{-03}	21.6	0.88%
South Golden	9.80×10^{-03}	2.20×10^{-03}	2.22	0.29%
Dean	1.02×10^{-02}	6.67×10^{-03}	13.6	1.70%
Pine Island	9.92×10^{-03}	6.82×10^{-03}	13.7	1.04%
Alternative B				
Ned Wilson	3.45×10^{-02}	5.46×10^{-03}	1.21	2.07%
Upper Ned Wilson	3.45×10^{-02}	5.46×10^{-03}	1.32	6.25%
Moon	1.53×10^{-02}	2.80×10^{-03}	13.7	0.80%
Deep Creek 1	1.38×10^{-02}	2.66×10^{-03}	21.6	0.88%
South Golden	9.66×10^{-03}	2.19×10^{-03}	2.21	0.29%
Dean	9.95×10^{-03}	6.67×10^{-03}	13.6	1.70%
Pine Island	9.74×10^{-03}	6.81×10^{-03}	13.7	1.04%
Alternative C				
Ned Wilson	3.52×10^{-02}	5.54×10^{-03}	1.22	2.11%
Upper Ned Wilson	3.52×10^{-02}	5.54×10^{-03}	1.34	6.35%
Moon	1.56×10^{-02}	2.84×10^{-03}	13.8	0.81%
Deep Creek 1	1.41×10^{-02}	2.69×10^{-03}	21.9	0.89%
South Golden	9.89×10^{-03}	2.22×10^{-03}	2.24	0.29%
Dean	1.03×10^{-02}	6.71×10^{-03}	13.7	1.71%
Pine Island	1.01×10^{-02}	6.85×10^{-03}	13.8	1.05%
Alternative D				
Ned Wilson	3.39×10^{-02}	5.44×10^{-03}	1.20	2.07%
Upper Ned Wilson	3.39×10^{-02}	5.44×10^{-03}	1.32	6.23%
Moon	1.50×10^{-02}	2.80×10^{-03}	13.6	0.79%
Deep Creek 1	1.35×10^{-02}	2.65×10^{-03}	21.5	0.88%
South Golden	9.43×10^{-03}	2.19×10^{-03}	2.21	0.29%
Dean	9.53×10^{-03}	6.66×10^{-03}	13.6	1.70%
Pine Island	9.36×10^{-03}	6.80×10^{-03}	13.7	1.04%

Table 4-175. Cumulative Nitrogen and Sulfur Deposition Maximum Predicted Potential Impacts from 2001–2003

Lake of Special Concern	Nitrogen (Dn) Deposition (kg/ha/yr)	Sulfur (Ds) Deposition (kg/ha/yr)	ANC Change (µeq/l)	Percent ANC Change
Alternative E				
Ned Wilson	3.40×10^{-02}	5.48×10^{-03}	1.21	2.09%
Upper Ned Wilson	3.40×10^{-02}	5.48×10^{-03}	1.33	6.28%
Moon	1.51×10^{-02}	2.82×10^{-03}	13.7	0.80%
Deep Creek 1	1.36×10^{-02}	2.67×10^{-03}	21.7	0.88%
South Golden	9.48×10^{-03}	2.20×10^{-03}	2.22	0.29%
Dean	9.61×10^{-03}	6.68×10^{-03}	13.6	1.71%
Pine Island	9.42×10^{-03}	6.83×10^{-03}	13.7	1.05%
Alternative F[1]				
Ned Wilson	3.49×10^{-02}	5.47×10^{-03}	1.21	2.08%
Upper Ned Wilson	3.49×10^{-02}	5.47×10^{-03}	1.33	6.26%
Moon	1.55×10^{-02}	2.81×10^{-03}	13.7	0.80%
Deep Creek 1	1.40×10^{-02}	2.66×10^{-03}	21.6	0.88%
South Golden	9.80×10^{-03}	2.20×10^{-03}	2.22	0.29%
Dean	1.02×10^{-02}	6.67×10^{-03}	13.6	1.70%
Pine Island	9.92×10^{-03}	6.82×10^{-03}	13.7	1.04%

[1] Impacts assumed to be equal to or less than Alternative A.

4.18.3.1.5 VISIBILITY IMPAIRMENT

The visibility assessment methodology used for this analysis used the BLM suggested method for performing visibility impact assessments (Archer 2008). This method involved a first level screening analysis for visibility following the recommendations in the FLAG (2000) Guideline document. If the seasonal screening analysis indicated that predicted changes in visibility exceeded the 1.0 deciview LAC on more than one day per year at any mandatory Federal PSD Class I area, a daily refined analysis was conducted based on hourly IMPROVE optical monitoring data measured at Canyonlands National Park for 1987 through 2004 (Archer 2006).

The screening results for the cumulative sources in addition to each alternative are presented in Table 4-176 to Table 4-181. Because there were changes in visibility that exceeded 1.0 deciview LAC on more than one day per year at various Class I areas, a refined analysis was performed. The refined analysis is contained in Table 4-182. Changes in visibility at sensitive Class II for both screening and refined methods are also provided for informational purposes.

Each alternative would have a very small incremental influence on the visibility impacts when combined with cumulative source impacts. Therefore, the Gasco project is not expected to have a substantial overall impact to visibility impairment in addition to other sources in the region. It should be noted that the cumulative impacts assume that all RFD development and operation emissions would occur within the same year. Although unlikely, this approach is one that is typically followed because there is no way to know how cumulative source will interact. Therefore, it is likely that actual cumulative visibility impacts would be below those presented in the following tables.

Discrepancies between the visibility cumulative results between the Greater Natural Buttes analysis and the Gasco FEIS are due to the refinement in the cumulative emission inventories used in the Greater Natural Buttes analysis versus the Gasco analysis. The Gasco far-field analysis was performed in 2008, and utilized the modeling protocols and emission inventories that were developed in 2008. The cumulative emission inventory for the Gasco EIS was based on foreseeable development from known NEPA projects, and permitting information from the Utah and Colorado regulatory agencies that was current at the time the analysis was performed. The Greater Natural Buttes analysis was completed at a later date, and incorporated a larger number of known NEPA projects, as well as projections for sources based on the WRAP Phase III inventory (2009). In short, the Gasco cumulative visibility far-field analysis was based on the best available data at the time.

The cumulative analysis performed for the *Greater Natural Buttes Draft EIS* (BLM 2010b) did incorporate the Gasco project, as well as additional projects and data not available at the time the analysis was performed for Gasco. This document incorporates the results from the *Greater Natural Buttes Draft EIS* by reference. The *Greater Natural Buttes Draft EIS* analysis showed greater cumulative impacts to visibility from the cumulative projects analyzed. For example, visibility impacts greater than 10% extinction at Class I areas included 311 days at Arches National Park, 236 days at Canyonlands National Park, and 348 days at Flat Tops Wilderness Area.

Table 4-176. Alternative A (Proposed Action) Screening Visibility Impacts

Area of Special Concern (Class)	2001		2002		2003	
	Days Δ dV >1.0	Max Δ dV	Days Δ dV >1.0	Max Δ dV	Days Δ dV >1.0	Max Δ dV
Arches NP (I)	15	2.66	22	2.58	20	2.84
Black Canyon of the Gunnison WA (I)	3	1.32	7	1.87	2	1.59
Canyonlands NP (I)	17	2.52	14	3.05	12	2.47
Capitol Reef NP (I)	5	3.00	4	1.93	2	1.19
Flat Tops WA (I)	9	1.65	13	1.78	10	2.02
La Garita WA (I)	0	0.34	0	0.85	0	0.56
Maroon Bells-Snowmass WA (I)	2	1.19	4	1.95	4	1.88
Weminuche WA (I)	0	0.73	4	1.35	1	1.10
West Elk WA (I)	0	0.64	0	0.62	0	0.59
Colorado NM (II)	14	2.11	22	2.65	17	2.59
Dinosaur NM (II)	200	8.46	180	11.02	167	8.66
Flaming Gorge NRA (II)	33	5.95	48	4.55	27	4.74
High Uintas WA (II)	7	1.19	39	6.67	15	5.31
Ouray NWR (II)	347	12.75	361	19.18	354	18.14
Ragged WA (II)	1	1.27	4	1.82	2	1.24

Table 4-177. Alternative B Screening Visibility Impacts

Area of Special Concern (Class)	2001		2002		2003	
	Days Δ dV >1.0	Max Δ dV	Days Δ dV >1.0	Max Δ dV	Days Δ dV >1.0	Max Δ dV
Arches NP (I)	13	2.45	16	2.39	17	2.60
Black Canyon of the Gunnison WA (I)	3	1.29	7	1.69	2	1.49
Canyonlands NP (I)	16	2.33	11	2.64	10	2.21
Capitol Reef NP (I)	4	2.75	4	1.73	2	1.04
Flat Tops WA (I)	6	1.62	13	1.67	10	1.86
La Garita WA (I)	0	0.33	0	0.77	0	0.55
Maroon Bells-Snowmass WA (I)	2	1.14	3	1.87	4	1.77
Weminuche WA (I)	0	0.72	4	1.24	0	0.57
West Elk WA (I)	0	0.63	0	0.60	1	1.03
Colorado NM (II)	12	2.75	19	2.54	146	8.38
Dinosaur NM (II)	180	8.03	168	10.44	15	2.41
Flaming Gorge NRA (II)	29	5.94	41	4.21	26	4.50
High Uintas WA (II)	6	1.42	35	5.82	353	16.3
Ouray NWR (II)	346	11.72	360	17.56	1	1.12
Ragged WA (II)	1	1.25	8	1.82	17	2.60

Table 4-178. Alternative C Screening Visibility Impacts

Area of Special Concern (Class)	2001		2002		2003	
	Days Δ dV >1.0	Max Δ dV	Days Δ dV >1.0	Max Δ dV	Days Δ dV >1.0	Max Δ dV
Arches NP (I)	15	2.74	23	2.66	21	2.94
Black Canyon of the Gunnison WA (I)	3	1.33	7	1.95	2	1.64
Canyonlands NP (I)	17	2.60	14	3.21	13	2.56
Capitol Reef NP (I)	6	3.12	6	2.02	3	1.24
Flat Tops WA (I)	9	1.69	13	1.82	10	2.08
La Garita WA (I)	0	0.34	0	0.89	0	0.56
Maroon Bells-Snowmass WA (I)	2	1.21	6	1.99	4	1.92
Weminuche WA (I)	0	0.73	4	1.40	1	1.14
West Elk WA (I)	0	0.65	0	0.65	0	0.59
Colorado NM (II)	14	2.16	23	2.72	17	2.71
Dinosaur NM (II)	202	8.66	181	11.22	171	8.78
Flaming Gorge NRA (II)	36	5.96	51	4.77	29	4.84
High Uintas WA (II)	8	1.61	40	7.05	16	5.53
Ouray NWR (II)	347	13.39	361	19.88	354	18.88
Ragged WA (II)	1	1.28	5	1.83	2	1.28

Table 4-179. Alternative D (No Action) Screening Visibility Impacts

Area of Special Concern (Class)	2001		2002		2003	
	Days Δ dV >1.0	Max Δ dV	Days Δ dV >1.0	Max Δ dV	Days Δ dV >1.0	Max Δ dV
Arches NP (I)	12	2.24	15	2.23	15	2.45
Black Canyon of the Gunnison WA (I)	3	1.27	7	1.58	1	1.42
Canyonlands NP (I)	12	2.15	8	2.41	9	2.04
Capitol Reef NP (I)	3	2.48	2	1.58	0	0.97
Flat Tops WA (I)	6	1.61	12	1.59	10	1.75
La Garita WA (I)	0	0.32	0	0.72	0	0.54
Maroon Bells-Snowmass WA (I)	2	1.09	3	1.87	4	1.70
Weminuche WA (I)	0	0.61	0	0.59	0	0.56
West Elk WA (I)	0	0.71	1	1.16	0	0.97
Dinosaur NM (II)	167	7.56	166	10.1	143	8.13
Colorado NM (II)	12	2.00	17	2.44	13	2.32
Flaming Gorge NRA (II)	25	5.92	40	4.00	21	4.30
Ouray NWR (II)	346	11.6	360	16.53	353	15.57
Ragged WA (II)	1	1.23	2	1.82	1	1.06
High Uintas WA (II)	4	1.27	32	5.17	12	4.51

Table 4-180. Alternative E Screening Visibility Impacts

Area of Special Concern (Class)	2001		2002		2003	
	Days Δ dV >1.0	Max Δ dV	Days Δ dV >1.0	Max Δ dV	Days Δ dV >1.0	Max Δ dV
Arches NP (I)	15	2.68	23	2.60	21	2.86
Black Canyon of the Gunnison WA (I)	3	1.32	7	1.87	2	1.60
Canyonlands NP (I)	17	2.52	14	3.06	13	2.49
Capitol Reef NP (I)	5	3.02	5	1.93	2	1.20
Flat Tops WA (I)	9	1.66	13	1.79	10	2.03
La Garita WA (I)	0	0.34	0	0.86	0	0.56
Maroon Bells-Snowmass WA (I)	2	1.19	4	1.95	4	1.89
Weminuche WA (I)	0	0.73	4	1.36	1	1.11
West Elk WA (I)	0	0.64	0	0.63	0	0.59
Colorado NM (II)	14	2.11	23	2.67	17	2.62
Dinosaur NM (II)	197	8.42	178	11.01	164	8.70
Flaming Gorge NRA (II)	33	5.96	47	4.58	27	4.77
High Uintas WA (II)	7	1.55	39	6.74	15	5.36
Ouray NWR (II)	347	12.69	361	19.14	353	18.04
Ragged WA (II)	1	1.27	4	1.82	2	1.25

Table 4-181. Alternative F[1] Screening Visibility Impacts

Area of Special Concern (Class)	2001		2002		2003	
	Days Δ dV >1.0	Max Δ dV	Days Δ dV >1.0	Max Δ dV	Days Δ dV >1.0	Max Δ dV
Arches NP (I)	15	2.66	22	2.58	20	2.84
Black Canyon of the Gunnison WA (I)	3	1.32	7	1.87	2	1.59
Canyonlands NP (I)	17	2.52	14	3.05	12	2.47
Capitol Reef NP (I)	5	3.00	4	1.93	2	1.19
Flat Tops WA (I)	9	1.65	13	1.78	10	2.02
La Garita WA (I)	0	0.34	0	0.85	0	0.56
Maroon Bells-Snowmass WA (I)	2	1.19	4	1.95	4	1.88
Weminuche WA (I)	0	0.73	4	1.35	1	1.10
West Elk WA (I)	0	0.64	0	0.62	0	0.59
Colorado NM (II)	14	2.11	22	2.65	17	2.59
Dinosaur NM (II)	200	8.46	180	11.02	167	8.66
Flaming Gorge NRA (II)	33	5.95	48	4.55	27	4.74
High Uintas WA (II)	7	1.19	39	6.67	15	5.31
Ouray NWR (II)	347	12.75	361	19.18	354	18.14
Ragged WA (II)	1	1.27	4	1.82	2	1.24

[1] Impacts assumed to be equal to or less than Alternative A

Table 4-182. Gasco Maximum of 2001–2003 Cumulative with Alternatives Refined Visibility Impacts for Each Alternative

Area of Special Concern (Class)	Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Preferred Alternative)
	Days Δ dV >1.0	Days Δ dV >1.0	Days Δ dV >1.0	Days Δ dV >1.0	Days Δ dV >1.0	
Arches NP (I)	3	2	3	2	3	Assumed equal to or less than Alt A
Black Canyon of the Gunnison WA (I)	5	4	6	4	6	Assumed equal to or less than Alt A
Canyonlands NP (I)	2	1	3	0	3	Assumed equal to or less than Alt A
Capitol Reef NP (I)	0	1	0	0	0	Assumed equal to or less than Alt A
Flat Tops WA (I)	15	13	15	12	15	Assumed equal to or less than Alt A
La Garita WA (I)	0	0	0	0	0	Assumed equal to or less than Alt A
Maroon Bells-Snowmass WA (I)	5	5	7	5	6	Assumed equal to or less than Alt A
Weminuche WA (I)	0	0	0	0	1	Assumed equal to or less than Alt A
West Elk WA (I)	4	4	4	2	3	Assumed equal to or less than Alt A
Colorado NM (II)	5	4	7	158	5	Assumed equal to or less than Alt A
Dinosaur NM (II)	188	173	193	3	186	Assumed equal to or less than Alt A
Flaming Gorge NRA (II)	42	41	50	41	47	Assumed equal to or less than Alt A
High Uintas WA (II)	39	33	40	351	38	Assumed equal to or less than Alt A
Ouray NWR (II)	353	352	355	2	352	Assumed equal to or less than Alt A
Ragged WA (II)	5	3	5	29	5	Assumed equal to or less than Alt A

4.18.3.1.6 OZONE IMPACTS

An analysis of potential ozone impacts from Gasco project emissions and cumulative emission sources was performed using the Models-3 CMAQ modeling system, version 4.6, publicly released in October 2006. A detailed discussion of ozone impacts is provided in the Ozone Impact Assessment (Appendix J). Hourly meteorological data were developed for the modeling domain using the MM5 meteorological models to simulate ozone dispersion. In order to simulate ozone formation, it was necessary to develop emissions estimates for all other emission sources (i.e., industrial, electric generation, motor vehicle, biogenic [natural]) in addition to the emissions from the Gasco project. The estimates were developed using the Western Regional Air Partnership (WRAP) emissions databases and were processed into CMAQ-ready files. Details concerning the emission inventories developed for use in the modeling are provided in Appendix J. Emissions inventory development for CMAQ ozone modeling addressed several source categories including: (a) stationary point sources, (b) area sources, (c) on-road mobile sources, (d) non-road mobile sources, (e) biogenic sources and (f) fire sources. Table 4-183 summarizes the cumulative emission inventory used for the ozone impact assessment.

Table 4-183. 12-km Emissions Modeling Domain Grid Totals (average tons/day)

Source Category	2018 Emissions Totals			2006 Emissions Totals		
	CO	NO_x	VOC	CO	NO_x	VOC
Area	211.3	31.1	264.3	93.3	17.5	113.5
NonRoad	574.4	31.4	85.2	775.0	102.8	83.5
Motor Vehicle	1,787.0	70.0	69.0	2,587.9	192.7	143.6
Point	362.8	505.4	120.3	225.2	662.6	50.6
Total Non-O&G	2,935.5	637.9	538.8	3,681.3	975.6	391.2
Piceance Basin O&G	11.0	10.0	42.0	0.2	17.3	59.7
Uinta Basin O&G	29.0	38.0	531.0	23.9	28.8	192.0
SWWY O&G	8.4	22.5	347.5	8.2	22.4	347.4
Other O&G	68.3	94.2	279.1	21.1	33.0	38.7
Total O&G	116.7	164.7	1199.6	53.4	101.5	637.8
Total	**3,052.2**	**802.6**	**1,738.4**	**3,734.7**	**1,077.1**	**1,029.0**

O&G = Oil and gas

Considerable caution must be taken in interpreting the results. In traditional CMAQ ozone modeling applications, the model is applied in regions with sufficient ozone and precursor monitors to judge the adequacy of the model for use in ozone prediction. It must be emphasized that EPA does not determine attainment of the 8-hour ozone standard based on the unmonitored area analysis. Rather, the unmonitored analysis is used as more of a weight of evidence analysis (EPA 2007e).

Using the relative non-monitored area analysis recommended by the EPA, no areas near the project are simulated to exceed the 75 ppb ozone standard with the implementation of the Proposed Action. The maximum predicted incremental impact from the Proposed Action with ACEPMs would be 0.4 ppb (Table 4-184). Gasco's application of ACEPMs would result in a 33% decrease in potential incremental project impacts, reducing potential ozone impacts from

0.6 ppb (without ACEPMs) to 0.4 ppb. For the Proposed Action, the areas of maximum ozone impact are predicted to remain below the 75 ppb ozone standard. Furthermore, no areas currently in attainment of the ozone standard would exceed the standard under the Proposed Action.

Table 4-184. Summary of Proposed Action Maximum Predicted Ozone Impacts (parts per billion)

Proposed Action Maximum Potential Ozone Impact Without ACEPMs	Proposed Action Maximum Potential Ozone Impact With ACEPMs	Difference in Maximum Potential Ozone Impacts as a Result of the Application of ACEPMs	Emission Reductions Associated with the ACEPMs
0.6	0.4	0.2	-853 tpy NO_X -11,249 tpy VOC

Future compliance with the NAAQS for ozone will be dependent on the review EPA is currently conducting on the appropriate concentration for both the primary and secondary standard for ozone. A reduction in the ambient standard for ozone could cause other areas in and near the project to show modeled exceedances of any new standard. Because EPA has not completed its review of the ozone NAAQS, it is premature at this time to speculate on what impact that review will have on compliance with the standard; however, once (or if) a new standard is promulgated, the project will be reviewed for compliance with the new standard under the adaptive management strategy outlined in Section 4.2.1.2.2 and Section 4.18.3.1.7.2.

In a separate analysis, the Independent Petroleum Association of Mountain States (IPAMS), in cooperation with oil and gas operators in the Uinta Basin, the BLM, and other regulatory agencies, conducted the Uinta Basin Air Quality Study (UBAQS). This study was used to estimate changes to air quality and AQRV within the Uinta Basin that may result from future industrial activity, including oil and gas development (IPAMS 2009). Data used as input for the UBAQS consisted of the most complete, accurate, and current emissions and meteorological data available at the time. Emissions data included the WRAP Phases II and III inventories for oil and gas sources in addition to other non-oil and gas emissions sources. Scaling factors, based on expected rates of development, were applied to the baseline emissions 2006 inventory, and “on-the-books” regulations were applied to the uncontrolled 2012 emissions projections to generate the final 2012 emissions projections by county for the six-county focus area of the UBAQS that comprises the Uinta Basin.

The UBAQS model results indicate that average ambient concentrations of criteria pollutants will remain below the NAAQS within the six-county Uinta Basin area. Specifically, the UBAQS results estimate that the Uinta Basin would be in attainment of the eight-hour ozone NAAQS for 2012 (IPAMS 2009). In terms of cumulative effects from the project, the Proposed Action is within the modeled scope of projected development, and as such, would not be expected to violate, or otherwise contribute to any violation, of any applicable air quality standard; nor would it be expected to contribute to any projected future potential exceedance of any applicable air quality standards.

4.18.3.1.7 OZONE MITIGATION MEASURES

4.18.3.1.7.1 Applicant-committed Environmental Protection Measures

Gasco has committed to implement project-specific Applicant-committed Environmental Protection Measures (ACEPMs) to reduce the emissions of ozone-forming precursors (NO_X and volatile organic compunds [VOCs]). The project specific-list can be found in Table 2-1.

Table 4-185 summarizes the reduction in ozone precursor NO_X and VOC emissions that would result from the implementation of the ACEPMs for Alternative A. As shown, the application of the ACEPMs would reduce NO_X emissions by 853 tons/year and VOC emissions by 11,249 tons/year. Additional project-related ACEPMs are presented in Table 2-1.

Table 4-185. Emission Reductions Resulting from the Implementation of ACEPMs, Alternative A (tons/year)

Applicant-committed Environmental Protection Measure	Emissions without ACEPM	Emissions with ACEPM	Effective Emissions Reduction
	(tpy)	(tpy)	(tpy)
Replacement of Tier 0 drill rigs with Tier II or better	1,175	528	-647
Elimination of well site compression and the application of central compression, thus allowing for the use of larger more efficient engines (1.0 g/hp-hr vs. 2.0 g/hp-hr NOx emission rate)	412	206	-206
Total NO_X	1,587	734	-853
Application of low-bleed pneumatics controllers on all new wells	2,444	419	-2,025
Replacement of high-bleed pneumatic controllers with low-bleed units on existing wells	205	35	-170
Replacement of pneumatic methanol pumps with solar powered pumps and the control of heat trace pumps	8,602	333	-8,269
Elimination of well site dehydration and the application of emission controls on central dehydrator with a 95% control efficiency	826	41.3	-784.7
Total VOC	**12,077**	**828**	**-11,249**

4.18.3.1.7.2 Adaptive Management Strategy/Ozone Action Plan

Monitored ozone exceedances in the Uinta Basin are cause for concern and potentially could result in a nonattainment designation for the region. In view of this, and unless otherwise specified, the applicant has committed to employ as part of the proposed project, and as part of an ozone action plan to mitigate additional adverse ozone impacts. A complete set of the measures can be found in Table 2-1.

Additionally, the applicant commits to developing a project-specific adaptive management strategy, to be informed by periodic emission inventory updates. Implementation of this strategy and associated application of “enhanced” ozone mitigation measures would be required once the proposed project is initiated if the following takes place:

1. The EPA designates the area “nonattainment” for ozone
2. There is a monitored ozone standard exceedance
3. The ARMS modeling shows that additional mitigation is needed to prevent future ozone exceedances; or
4. The ARMS group establishes industry-wide mitigation requirements through ongoing modeling

If implementation of this adaptive management strategy is triggered, the applicant commits to working with the BLM to analyze project-specific “enhanced” mitigation measures and employ them within 1 year. The measures to be considered could include, but would not be limited to, the following:

- Reducing the total number of drill rigs
- Installing Tier IV or better drill rig engines
- Seasonally reducing or ceasing drilling during specified periods
- Using only lower-emitting drill and completion rig engines during specified time periods
- Using natural gas–fired drill and completion rig engines
- Replacing internal combustion engines with gas turbines for natural gas compression
- Using electric drill rig or compression engines
- Centralizing gathering facilities
- Limiting blowdowns or restricting them during specified periods
- Installing plunger lift systems with smart automation
- Employing a monthly Forward Looking Infrared (FLIR) program to reduce VOCs
- Enhancing a direct inspection and maintenance program
- Employing tank load out vapor recovery
- Employing enhanced VOC emission controls with 95% control efficiency on additional production equipment having a potential to emit greater than 5 tpy

In addition to the commitments above, the applicant commits to complying with applicable air pollution control rules and regulations.

The high ozone levels reported in the Uinta Basin in the winter of 2010 prompted the BLM to begin developing an adaptive management strategy for Uinta Basin operations to address ozone levels in excess of the NAAQS with the goal that this and other oil and gas development projects in the basin under BLM jurisdiction would not contribute to ozone exceedances.

Air quality issues are being addressed on a Utah-wide basis through the UTAG and the BLM's ARMS. The adaptive management strategy outlined below has been designed to develop an ozone action plan to address ozone levels in the Uinta Basin associated with oil and gas operations. The adaptive management strategy would consist of the following actions:

- Refine air quality modeling predictions
- Develop a Uinta Basin ozone action plan
- Implement a regional ozone action plan

The first 2 elements of this strategy are being implemented by the BLM and other agency stakeholders, independent of the decision to be made regarding further development in the Uinta Basin. Regional operators may participate in these initial planning steps, thereby having the opportunity to contribute to the outcome of the process. The third element would require specific action by Gasco and other oil and gas operators in the Uinta Basin following approval of the ROD. All three elements are described in more detail in the following paragraphs.

Refine Air Quality Modeling Predictions

The ARMS adaptive management strategy involves conducting a regional photochemical modeling analysis to compare and evaluate the effect of different mitigation activities on the ozone levels in the Uinta Basin. This modeling would be conducted in consultation with appropriate federal, tribal, and state stakeholders as well as with regional oil and gas operators. The aim of the modeling effort is to compare the effect of changes in VOC and NO_X emissions, under various control strategies, to model-predicted change in ozone levels. Separate comparisons may be made for winter and summer periods. An updated emissions inventory, observed ozone levels within the basin, and corresponding meteorological data would be used.

Modeling results would provide an estimate of ozone region-wide and depict spatially the effectiveness of different emission controls on ozone formation in the Uinta Basin. The BLM would isolate the project-specific incremental ozone increases from the ARMS modeling immediately following completion of the region-wide modeling effort.

The updated air quality modeling analysis utilizing the new inventory and monitored data would be performed within 2 years of signing the ROD. This would be accomplished by isolating project-specific impacts from the ARMS regional scale air quality modeling study, if available. The modeling would consider the current emission inventory data to be updated periodically, current operating practices, applicant-committed mitigation, and any applicable Best Available Control Technology (BACT) requirements in place at the time the modeling is conducted. The BLM, in consultation with appropriate federal, state, and tribal stakeholders, would evaluate the modeling results and identify any needed additional reductions in ozone precursor emissions.

As soon as possible following evaluation of the modeling results, the BLM and appropriate stakeholders would use their respective authorities to implement any needed emission-control mitigation measures and/or operating limitations necessary to ensure continued compliance with applicable ambient air quality standards for ozone. Absent an effective technology to implement, reductions in the pace of development may be utilized to ensure ambient air quality standards are met.

Develop an Ozone Action Plan.

Based on the results of the photochemical modeling study, the BLM would develop an ozone action plan that would describe mitigation to be enacted to address observed ozone levels above the NAAQS. The plan would be developed in consultation with appropriate federal, tribal, and state stakeholders. Regional oil and gas operators also may participate in the plan's development. Specific criteria would be identified in the plan for determining when additional mitigation would be initiated and which measures would be recommended. Criteria also would be specified for when the use of additional mitigation could be suspended based on observed ozone concentrations. Potential mitigation strategies are included in the list of "enhanced mitigation measures" presented above.

Implement an Ozone Action Plan.

The BLM would evaluate monitored ozone ambient air quality data at sites in the Uinta Basin to determine when to implement the ozone action plan. Monitoring data would be obtained, summarized, and reviewed on an ongoing basis following quality assurance review of each dataset. Based on the data review and the criteria set forth in the ozone action plan, the BLM, in consultation with the appropriate federal, tribal, and state stakeholders, would determine when to trigger implementation of the plan. Following issuance of the ROD, Gasco and other operators in the Uinta Basin would be required to participate in the implementation of the BLM-approved ozone action plan in the Uinta Basin.

The applicant, in consultation with the BLM and appropriate federal, tribal, and state stakeholders, would employ "enhanced mitigation measures" as warranted through the ozone action plan within 1 year of a nonattainment designation or monitored ozone standard exceedance.

The BLM would ensure that appropriate ambient air monitoring is occurring in the Uinta Basin. The BLM and/or the operator, in consultation with the UTAG, would establish monitoring sites in the event that additional monitored data are necessary. These monitors would conform to EPA monitoring protocols (40 CFR 50 and 58), with emphasis on obtaining measurements that contribute to the formation of secondarily formed pollutants such as $PM_{2.5}$ and ozone to ensure that monitoring data are valid and useful in calibrating the model and determining control strategies.

4.18.3.1.8 Climate Change

The human and natural causes of climate change and the impacts of climate change are global in scope. Greenhouse gas (GHG) emissions, which have been shown to contribute to climate change, do not remain localized, but become mixed with the general composition of the Earth's atmosphere. Therefore, this analysis cannot separate the particular contribution of this project's GHG emissions to regional or global climate change from the many other past, present, and reasonably foreseeable projects that have produced or would produce or mitigate GHG emissions. Rather, this analysis focuses on the cumulative effects of GHG emissions and climate change from a global perspective.

Background

Changes in the global climate as a consequence of warming produced by increasing atmospheric concentrations of GHGs are a worldwide environmental issue. GHGs include water vapor, CO_2, methane, nitrous oxide, ozone (O_3), and several chlorofluorocarbons. Although GHGs constitute a small percentage of the Earth's atmosphere, they are entirely responsible for its heat-trapping properties. Water vapor, a natural component of the atmosphere, is the most abundant GHG, but its atmospheric concentration is driven primarily by changes in the Earth's temperature. As such, water vapor simply serves to amplify the effects of other GHGs such as CO_2. The second-most abundant GHG is CO_2, which remains in the atmosphere for long periods of time. Due to human activities, atmospheric CO_2 concentrations have increased by approximately 35% over preindustrial levels. Fossil fuel burning, specifically from power production and transportation, is the primary contributor to increasing concentrations of CO_2 (IPCC 2007a). In the United States, stationary CO_2 emission sources include energy facilities (such as coal and natural gas power plants) and industrial processes such as cement manufacture, limestone and dolomite calcination, soda ash manufacture and consumption, CO_2 manufacture, and aluminum production (Department of Energy 2010). In addition, industrial and agricultural activities release GHGs other than CO_2—notably methane, NOx, O_3, and chlorofluorocarbons—to the atmosphere, where they can remain for long periods of time.

In the preindustrial era (before 1750 A.D.), the concentration of CO_2 in the atmosphere appears to have been 275 to 285 ppm (IPCC 2007a). In 1958, C.D. Keeling and others began measuring the concentration of atmospheric CO_2 at Mauna Loa in Hawaii. The data collected by Keeling's team and others since then indicate that the amount of CO_2 in the atmosphere has been steadily increasing from approximately 316 ppm in 1959 to 386 ppm in 2008 (National Oceanic and Atmospheric Administration [NOAA] 2010). This increase in atmospheric CO_2 is attributed almost entirely to human activities.

Impacts of GHG on Climate

Climate is usually defined as the average weather of a region. Relevant parameters include temperature, precipitation, wind, and dates of meteorological events such as first and last frosts, beginning and end of rainy seasons, and appearance and disappearance of pack ice.

Changes in climate are difficult to detect because of natural variability in meteorological patterns over long periods of time and across broad geographical regions. There is much uncertainty regarding the extent of global warming caused by human-induced GHG emissions, the climate changes this has or will produce, and appropriate strategies for stabilizing GHGs in the atmosphere. The World Meteorological Organization and United Nations Environment Programme established the Intergovernmental Panel on Climate Change (IPCC) to provide an objective source of information about global warming and climate change. According to the IPCC fourth assessment report, "[w]arming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level" (IPCC 2007b). The IPCC report finds that the global average surface temperature has increased by approximately 0.74 degrees Celsius in the last 100 years, global average sea level has risen approximately 150 millimeters over the same period, and cold days, cold nights, and frosts over most land areas have become less frequent during the past 50 years. The report concludes that most of the temperature increase since the middle of the twentieth century "is very likely due to the observed increase in anthropogenic [GHG] concentrations."

The 2007 report estimates that, at present, CO_2 accounts for approximately 77% of the global warming potential attributable to human-caused GHGs releases; most of this CO_2 (74%) comes from the combustion of fossil fuels. CO_2 would continue to contribute more than 70% of the total warming potential under all of the scenarios considered in the report. The IPCC therefore believes that further warming is inevitable, but that global warming and its effects on climate could be mitigated by stabilizing the atmosphere's concentration of CO_2 through the use of 1) "low-carbon technologies" for power production and industrial processes; 2) more efficient use of energy; and 3) management of terrestrial ecosystems to capture atmospheric CO_2 (IPCC 2007b).

Environmental Impacts of Climate Change

The IPCC and the U.S. Climate Change Science Program have examined the potential environmental impact of climate change at global, national, and regional scales. The IPCC report states that, in addition to increases in global surface temperatures, the impacts of climate change on the global environment may include

- more frequent heat waves, droughts, and fires;
- rising sea levels and coastal flooding;
- melting glaciers, ice caps, and polar ice sheets;
- more severe hurricane activity and increases in frequency and intensity of severe precipitation;
- spread of infectious diseases to new regions;
- loss of wildlife habitats; and
- heart and respiratory ailments from higher concentrations of ground-level O_3 (IPCC 2007b).

Most of the United States is expected to experience an increase in average temperature (IPCC 2007b). Changes in precipitation are more difficult to project. In some seasons, some areas within the West will experience an increase in precipitation, other areas will experience a decrease, and yet others will see little change (Karl et al. 2009). Therefore, although global warming could cause temperature increases in the Uinta Basin, it is unclear where precipitation could increase or decrease. If precipitation decreases, semi-arid conditions would increase in the Uinta Basin. However, if precipitation increases, vegetation in the Uinta Basin could increase.

Increases in GHGs are likely contributing to the following climate trends that have been observed over much of the western United States during the past 50 years (BRAC 2007):

- A several day increase in the frost-free growing season
- An earlier and warmer spring
- Earlier flower blooms and tree leaf out for many plant species
- Earlier spring snowmelt and run off
- A greater fraction of spring precipitation falling as rain instead of snow

Most of the western United States is warming faster than the global average. In Utah, the average temperature during the past decade was higher than observed during any comparable period of the past century (roughly 2 degrees Fahrenheit higher than the 100-year average) (BRAC 2007). Utah is projected to warm more than the global average, likely resulting in fewer frost days, longer growing seasons, and more heat waves (BRAC 2007). In addition, continuing GHG emissions at or above current levels will likely result in a decline in Utah's mountain snowpack and associated changes to spring runoff, as well as episodes of severe and prolonged drought. Because of increasing temperatures, soils are expected to dry more rapidly, which will likely contribute to erosion and increased dust transport during high wind events. (BRAC 2007).

In 2005, Utah accounted for approximately 69 million metric tons (MMt) of gross carbon dioxide equivalent (CO_2e) emissions. This is approximately 1% of the total United States gross GHG emissions (Center for Climate Strategies 2007). From 1990 to 2005, Utah's gross GHG emissions increased 40%, compared to a national emissions increase of 16% during this period (Center for Climate Strategies 2007). Electricity use is the primary source of Utah's GHG emissions and accounted for 37% of gross GHG emissions in 2005. The next largest sources are the transportation sector (25%), and the residential, commercial, and industrial fossil fuel combustion sector (18%) (Center for Climate Strategies 2007).

Utah's gross GHG emissions are projected to reach 96.1 MMt of CO_2e per year by 2020, 95% above 1990 levels. Emissions from the generation of electricity are projected to be the largest contributor, followed by emissions from the transportation sector (Center for Climate Strategies 2007).

The BLM obtained historical climate data for Myton, Utah, from the Western Regional Climate Center (WRCC). The WRCC is one of six regional climate centers in the United States administered by NOAA. WRCC data are derived from the National Climatic Data Center, the National Weather Service, the Natural Resources Conservation Service, and other federal, state, and local agencies. Temperature, snowfall, and precipitation data was examined. Based on a graph of annual average temperatures from 1918 to 2010, the average temperature in Myton has increased several degrees over this time period. A graph of annual total snowfall data in Myton from 1927 to 2011 indicates that annual snowfall totals have decreased over the last 84 years. Annual total precipitation in Myton has increased very slightly from 1916 to 2010, according to a graph of precipitation data. Myton's temperature and snowfall data supports general climate change trends and projections for Utah. The slight increase in precipitation in Myton may support the observed western United States trend that a greater fraction of spring precipitation is falling as rain instead of snow.

Cumulative Contribution of Potential GHG Emissions from the Gasco Project

Impacts of GHG emissions are by nature global and cumulative impacts, as individual sources of GHG emissions are not large enough to have an appreciable effect on climate change. In keeping with guidance from the Council on Environmental Quality (CEQ), the focus of the cumulative air quality GHG analysis is on GHG emissions affected by the Proposed Action and as compared to the No Action Alternative (CEQ 2010). The impact of proposed GHG emissions is discussed in the context of the combined impacts as compared to the total amount of GHG emissions that the United States produces.

In 2009, the United States generated approximately 6,632 Tg CO_2 Eq (USEPA 2011). Although 2009 or more recent GHG emissions data for Utah has not been collected by the Utah Division of Air Quality (Hanks 2011), projected GHG emissions for Utah in 2010 were 75.6 MMt of CO_2e (Center for Climate Strategies 2007). Annual emissions of CO_2 from the Gasco project (0.13 to 0.6 Tg CO_2 Eq) would add to these emissions. If the Gasco Project does not go forward, it cannot be assumed that the additional emissions attributed to the project would be avoided. Oil and gas development in the Uinta Basin is ongoing, and other oil and gas projects would likely be proposed in its place, although development could take longer. Consequently, overall global GHG emissions are likely to remain near the current level on a regional or global scale under the Proposed Action.

4.18.3.2 CULTURAL RESOURCES

The CIAA for impacts to cultural resources is the Vernal FO planning area. This CIAA accounts for impacts to cultural resources that exist within the Uinta Basin and are collectively affected by ongoing resource management and energy extraction in this region. Cumulative impacts to cultural resources within Nine Mile Canyon are also addressed. Cumulative effects from recreation, vegetation treatments, livestock management, and mineral use are difficult to quantify. However, past oil and gas exploration in the CIAA has disturbed an estimated 45,803 acres of land with high and low potential for the occurrence of cultural resources (BLM 2008b). Many sites in the Gasco project area are shallow, and could be damaged or destroyed by vegetation clearing, ROW blading, or disturbance or excavation of soils. Standing historic buildings or structures are less likely to be impacted by surface disturbing activities as they are more visible than archaeological deposits, but may be impacted by livestock or wildlife rubbing up against the structure. Cultural resources have also been subject to indirect impacts, including vandalism, surface artifact collection, dust accumulation, unauthorized excavation, and damage from off-road traffic, because of access to the area from between 4,707 and 4,861 miles of routes. The improvement and construction of 800 miles of motorized trails for backcountry recreational driving would result in 1,148 acres of surface disturbance and provide further access to cultural resources.

Reasonably foreseeable future actions and development would create 4,763 miles of new roads that would result in 63,213 acres of surface disturbance. In particular, the West Tavaputs Plateau Proposed Action would result in traffic increases in Nine Mile Canyon during its development and production phase of over 550% and 240%, respectively (BLM 2010a). The impacts to cultural resources would include vandalism, collection, dust accumulation, excavation, and direct damage, as described above.

Additionally, the WTP dust suppression plan proposes to discontinue the use of magnesium chloride – substance believed to have a corrosive effect on at least some rock types on which rock art is found – within canyon bottoms and use products such as lignin sulfonate or a soluble polymer, or improve the road with hard surfacing, such as asphalt, chip and seal, or other materials. Implementation of the dust suppression plan has the potential to substantially reduce dust generated by increased project-related traffic in these areas. The elimination of magnesium chloride and the hard-surfacing of roads would reduce sources of potential indirect effects to cultural resources in both the short- and long-term.

Road improvements associated with the WTP project may result in an increase in overall visitation to the general area, which could result in unauthorized collection of artifacts or damage to sites; however, vandalism is less likely to occur at sites where more people are present (BLM 2010a). Other anticipated actions would also impact cultural resources. Actions that result in surface disturbance, including recreation; livestock grazing; construction of livestock facilities, wildlife guzzlers, new roads and trails, and fire lines; and vegetation treatments would have the potential to impact cultural resources. These impacts could be similar to the energy development impacts described above. The difference would be a lesser degree or magnitude of impact, as less land area would be disturbed. Other actions, however, would protect cultural resources, including designation of the Nine Mile Canyon ACEC, to give priority and emphasis to protection of the canyon's outstanding cultural values. Under the Proposed Action, natural gas development would cumulatively contribute approximately 1,358 acres of surface disturbance and 60 miles of new road within zones of high probability for cultural resources and 6,226 acres of surface disturbance and 266 miles of new road within the low probability zones. The impacts to cultural resources in the project area would be the same as other energy development throughout the CIAA, and the Gasco development would add cumulatively to the overall impact of energy development on cultural resources in the CIAA. Alternative B would contribute 1,124 acres of disturbance and 60 miles of new roads within zones of high probability for cultural resources and 4,562 acres of disturbance and 214 miles of new roads in low probability zones, somewhat less than the Proposed Action. Alternative C would contribute 1,936 acres of disturbance and 116 miles of new road in high probability zones and 8,045 acres of disturbance and 421 miles of new roads in low probability zones, more than the Proposed Action. The No Action Alternative would contribute 613 acres of surface disturbance and 25 miles of new roads in high probability zones and 1,442 acres and 47 miles in low probability zones, substantially less than the Proposed Action. Alternative E would contribute 429 acres of surface disturbance and 24 miles of new roads in high probability zones and 1,745 acres of disturbance and 82 miles of new roads in low probability zones. Alternative F would contribute 657 acres of surface disturbance and 40 miles of new roads in high probability zones and 2,944 acres of disturbance and 157 miles of new road in low probablility zones. Although the areas of impact to high and low probability zones for cultural resources varies under each of the alternatives, the impacts to cultural resources would be the same as described for the Proposed Action, just to different degrees (lower under three alternatives and higher under one).

Under the Proposed Action, natural gas development would not contribute to cumulative surface disturbance below the rim of Nine Mile Canyon, but would add approximately 844 acres of surface disturbance within the Nine Mile Canyon Special Recreation and Cultural Management Area (SRCMA) (see Table 4-186). These surface disturbances would have similar impacts to cultural resources as the impacts described above, and could include vandalism, collection, dust accumulation, excavation, and direct damage, as described above. In general, disturbance within the rim of the canyon has a higher risk of impact to cultural resources. Of the sites used in the analysis section of the Class I literature review for the WTP EIS (BLM 2008d), 81.1% occur in the major canyons and the remaining 19.1% of the sites occur in upland (plateau) settings.

The SRCMA encompasses the 78-mile Nine Mile Canyon Backcountry Byway and its viewshed, the potential Nine Mile Canyon Archeological district, and the Nine Mile Canyon ACEC. Reasonably foreseeable projects would cumulatively contribute up to 600 acres of disturbance within the SRCMA in addition to approximately 122 acres of existing disturbance due to past natural gas development (BLM 2008a).

Table 4-186. Cumulative Impacts within the Nine Mile Canyon SRCMA

	Acres Proposed Disturbance under Gasco EIS (% disturbance below the canyon rim)	Acres Existing Disturbance[1]	Acres Reasonably Foreseeable Projects[2]	Cumulative Disturbance (% from Gasco EIS Alternative)
Alternative A (Proposed Action)	1,490 (0.3% below rim)	122	600	2,662 (73%)
Alternative B (Reduced)	912 (1.8% below rim)	122	600	1,634 (56%)
Alternative C (Full)	2,040 (27% below rim)	122	600	2,762 (74%)
Alternative D (No Action)	235 (0% below rim)	122	600	957 (25%)
Alternative E (Directional)	348 (2.5% below rim)	122	600	496 (70%)
Alternative F (Agency Preferred)	924 (0% below rim)	122	600)	1,646 (56%)

[1] UDOGM 2010 well data Includes 48 wells within the Price FO and 305 within Vernal FO. A suface disturbance factor 2.55 acres per well was applied to each well to derive acres of disturbance.

[2] RFD projects: West Tavaputs Plateau EIS, Newfield EDA EA, Newfield Monuments Buttes EIS and Programmatic EIS for Tribal lands. Surface disturbance for the other projects is based on on percentage of project within the SRCMA (see Table 1-138 for project and surface disturbance acreage project totals).

Under the Proposed Action, 1,490 acres would be disturbed within the SRCMA, with less than 1% occurring below the canyon rim. This would equate to 73% of the total cumulative disturbance within the SRCMA (see Table 4-186). Under Alternative B, 912 acres would be disturbed within the SRCMA, with 2% occurring below the canyon rim. This would equate to 56% of the total cumulative disturbance within the SRCMA. Under Alternative C, 2,040 acres would be disturbed within the SRCMA, with 28% occurring below the canyon rim. This would equate to 74% of the total cumulative disturbance within the SRCMA. Under the No Action Alternative, 235 acres would be disturbed within the SRCMA, with 0% occurring below the canyon rim. This would equate to 25% of the total cumulative disturbance within the SRCMA. Under Alternative E, 348 acres would be disturbed within the SRCMA, with 3% occurring below the canyon rim. This would equate to 70% of the total cumulative disturbance within the SRCMA. Under Alternative F, 924 acres would be disturbed within the SRCMA, with 0% occurring below the canyon rim. This would equate to 56% of the total cumulative disturbance within the SRCMA.

Surface disturbance and the presence of new above-ground facilities under all alternatives would contribute to the cumulative indirect visual effects on cultural resources within the project area and the broader APE. Based on existing data, 236 cultural resources sites that are both eligible for and susceptible to effects from visual intrusions were identified in the Gasco project area. An additional 467 such sites were identified in the broader APE. Stipulations for the use of low profile, camouflaged, and other specially designed facilities in the vicinity of sites vulnerable to visual intrusions would minimize the net effect of these cumulative impacts on cultural resources.

It should be noted that cultural resources are afforded protection under several laws, including the Antiquities Act of 1906, National Historic Preservation Act of 1966, and the Archaeological Resources Protection Act of 1979. The identification of sites and data recovery conducted in association with the Section 106 process for land uses increases the knowledge of cultural resource in the development area.

4.18.3.3 Geology and Minerals

The CIAA for impacts to geology and minerals is the Vernal FO planning area, which encompasses an area of expanding mineral development managed under a common land use plan. Throughout the CIAA, natural gas development and production has and would continue to have some (slight) impact to other subsurface resource uses, including STSAs, oil shale (Known Oil Shale Lease Areas), gilsonite, locatable minerals (gold and uranium), mineral materials (sand, gravel, and building stone), and coal by contaminating the resource with drilling fluids or physically obstructing access to these other resources with the presence of roads, well pads, and well casings. The impact would be greatest where larger areas are under lease for tar sands, oil shale, or gilsonite.

Oil and gas development in the CIAA has been, and is expected to continue to be, extensive. UDOGM 2010 well data show an existing 14,981 wells in the Vernal FO, and over 23,814 wells are expected to be developed in the CIAA over the next 15 years. Exploration for oil and gas reserves has diminished as infill projects are developed in known fields. Infill drilling continues to be proposed on decreased spacing, resulting in increasingly greater density of surface disturbance and installation of facilities. Extraction of natural gas from geologic formations underlying the CIAA would be irreversible and would cumulatively add to depletions of oil and natural gas resources across the CIAA.

In the CIAA the potential for the development of tar sands, other than for use as asphalt paving, is expected to remain low as the industry continues to search for economically viable methods to extract oil from this resource. The number of tar sands mining operations that may occur would be dependent on the lease holders and cannot be predicted. Production of gilsonite is expected to continue at approximately 60,000 tpy over the next 15 years, and approximately 10 lease sales are anticipated. However, the number of mines that may be developed cannot be predicted. Current approved mines are expected to produce in the next 15 years. Conditions are not expected to result in any significant oil shale development over the next 15 years, though some development is likely. One or two small-scale projects are anticipated. There has not been any phosphate production on federal leases and no lessees have indicated their intent to begin production. One existing mine is expected to continue production. Phosphate occurrence and development potential exists along the north and south slopes of the Uinta Mountains. There will continue to be moderate demand for sand and gravel, with most material coming from existing free-use permits. No more than six new permits would be issued over the next 15 years, and 2 contract sales are possible. There could be as many as 8 applications for building stone sales. Little development activity for locatable minerals is expected in the next 15 years, and it is very unlikely coal would be developed in CIAA over the planning period (BLM 2004b). However, in those areas where leasable and locatable minerals are mined, the impacts of oil and gas development on recovery of those minerals would be the same as describe above.

Natural gas production under the Gasco project alternatives would make the producing areas difficult to develop for tar sands, oil shale, and gilsonite due to surface disturbing activities.

Because tar sands, oil shale, and gilsonite are found below the surface, development would be difficult because existing gas production facilities would occupy the land and would prohibit access to areas below the facilities. Impacts to subsurface resources include potential contamination from drilling fluids and physical obstruction from the presence of well casings. Under the Proposed Action, zero acres of tar sands would be affected; 1,361 acres of oil shale would be affected; and 1 acre of gilsonite would be affected. Development of natural gas in the Gasco project area would not add substantially to the impacts of oil and gas development on development and production of these mineral resources because there are few acres under lease in the project area for these other mineral resources, and little production is anticipated. Under Alternative B, 0 acres of tar sands, 933 acres of oil shale, and 1 acre of gilsonite would be affected. Under Alternative C, 104 acres of tar sands, 1,811 acres of oil shale, and zero acres of gilsonite would be affected. Under the No Action Alternative, zero acres of tar sands, 459 acres of oil shale, and 1 acre of gilsonite would be affected. Under Alternative E, 0 acres of tar sands, 413 acres of oil shale, and zero acres of gilsonite would be affected. Under Alternative F, 103 acres of tar sands, 1,283 acres of oil shale, and zero acres of gilsonite would be affected. Although the acreage of land affected under the alternatives varies somewhat from the Proposed Action, the impacts would be the same as described for the Proposed Action. The alternatives would not contribute more than negligibly to impacts of gas production on other mineral resources. Cumulative effects from recreation, vegetation treatments, and livestock management are difficult to quantify.

The cumulative impacts of natural gas production on uranium and gold would also be negligible because there are currently no mining claims in the project area. Additionally, there is a low potential for new mining claims to be issued over the life of the Gasco project due to regulatory requirements, low economic quality, and small quantity of deposits in the project area (Section 3.4, Geology and Minerals). Cumulative effects from recreation, vegetation treatments, and livestock management, are difficult to quantify.

Cumulative impacts of natural gas production on sand and gravel resources are not anticipated from the addition of the Gasco project because more convenient supplies are located on other public lands within the Uinta Basin (BLM 2008b). Potential adverse impacts to building stone/decorative rock could result from proposed access roads and their potential to increase opportunities to collect these resources. Additionally, because decorative rock is an aboveground resource, it is susceptible to surface disturbing activities. Under the Proposed Action 1,049 acres would be affected. However, because there are more accessible supplies of salable mineral outside the project area, the cumulative impact from the Proposed Action would be negligible. Under Alternatives B, C, D, E, and F, 450 acres, 1,582 acres, 264 acres, 276 and 522 acres would be affected, respectively. The number of acres affected varies by alternative, but the cumulative effects under Alternatives B, C, D, E, and F would be the same as described for the Proposed Action, just in different degrees.

Cumualtive effects from recreation, vegetation treatments, and livestock management are difficult to quantify.

4.18.3.4 Land Use and Transportation

The CIAA for impacts to land use and transportation is the BLM Vernal FO planning area. This CIAA encompasses an area of expanding mineral development managed under a common land use plan and generally accessed from the same communities. A variety of past, current, and reasonably foreseeable land uses (including recreation, vegetation treatments, and livestock management) have and would impact land use and transportation in the CIAA, though the cumulative effects from recreation, vegetation treatments, livestock management, and other mineral use (oil shale, tar sands, locatable minerals, and salable minerals) are difficult to quantify. The development of the oil and gas industry is a continuing and substantial land use in the region. The growth of that industry has resulted in increased vehicle traffic. Providing access to public lands for recreationists, ranchers, miners, utility companies, researchers, agency administrators, and other users has required and would continue to require securing legal access across other landowners' property. There are currently at least 14,374 miles of existing roads in the CIAA (see Section 4.18.2.2). Many of these have required ROWs or other means of legal access from landowners in the CIAA. These routes also constitute a transportation network which serves the resource development industry, land managers, and recreationists (including OHV users).

Reasonably foreseeable future actions include construction and improvement of approximately 4,763 miles of new motorized routes and oil and gas access roads associated with over 23,814 oils and gas wells. These roads would often require ROWs, and would expand the transportation network in the CIAA. Necessary easements would have to be negotiated with the respective landowner and secured through a permitting process.

Under this Proposed Action, 83% of proposed surface disturbance would occur on BLM-administered public lands, 15% would occur on state lands (nearly all owned by SITLA), and 2% would occur on private lands. The primary means of access to the project area would be via Sand Wash, and Wells Draw roads, but oil and gas exploration and production would require further acquisition of easements across landowners' property. These roads would also provide access to other development projects in the the CIAA. Over the next 15 years, 4,763 miles of access road would be constructed in these development areas in support of oil and gas exploration and production. The Proposed Action would contribute an additional 1,491 wells to the projected total of 23,814 wells expected to be developed in the CIAA over the next 15 years, and 325 miles (6%) of the projected miles of new road construction in this portion of the CIAA to support that development. Under Alternative B, proposed surface disturbance would occur on 79% BLM, 20% state, and 2% private, and that development would contribute 1,114 wells and 274 miles (5%) of new road to the projected development in the CIAA. Under Alternative C, proposed surface disturbance would occur on 85% BLM, 14% state, and 1% private, and contribute 1,887 new wells and 526 miles (10%) of new road to the projected development in the CIAA over the next 15 years. Under the No Action Alternative, proposed surface disturbance would occur on 75% BLM, 24% state, and 1% private, and contribute 368 new wells and 72 miles (1%) of new roads to projected development in the CIAA. Under Alternative E, proposed surface disturbance would occur on 80% BLM, 18% state, and 2% private, and contribute 1,114 new wells and 106 miles (2%) of new road. Under Alternative F, proposed surface disturbance would occur on 83% BLM, 16% state, and 1% private, and contribute 1,298 new wells and 198 miles (4%) of new road.

All of these growing land uses and associated new access roads have resulted in, and would continue to result in increased vehicle traffic. Impacts due to increased traffic include

- delays for recreational users;
- increased risk of traffic accidents and collisions with wildlife and livestock; and
- increased road maintenance needs.

These impacts would occur throughout the CIAA, and would be compounded by implementation of any of the alternatives.

In areas where oil and gas development is already in existence, more dead-end roads would be built as additional wells are installed. Furthermore, as exploration moves into areas with less of an existing road network, arterial roads would be constructed in addition to dead-end roads. Project-related traffic on these roads would be greatest during construction, drilling, and completion phases. An increase in road construction would lead to greater recreational access for OHV users, hikers, and hunters, but could also detract from the experience of those who value recreational experiences in a natural setting removed from motorized sights and sounds. Increases in road construction could also ultimately adversely impact game availability, due to loss of forage, noise and persistent human presence, habitat fragmentation, and increased hunting pressures. Additionally, increased access by passenger vehicles could result in an increased probability of accidents with the large oils and gas trucks utilizing the same roads.

Of particular concern is the potential for cumulative impacts to the Nine Mile Canyon Backcountry Byway, particularly within the canyon itself. Nine Mile Canyon's National Backcounty Byway designation is based on the profusion of Fremont culture rock panels and cliff granaries located within Nine Mile Canyon and up side canyons (see Section 3.5); the portion of the Byway that is within the canyon is currently used primarily for development activities and cultural and heritage tourism. 2005 traffic studies reported an ADT of 78 in the upper portions of the canyon and an ADT of 26 in the southern portions of the canyon (BLM 2010a). During peak development of the West Tavaputs Plateau Project, traffic increases in Gate Canyon/Wells Draw Road area (representing the northern end of the canyon) would result in an ADT of 431, a 553% increase over existing conditions. Traffic increases in the Soldier Creek mine area of the Nine Mile Canyon Backcountry Byway (representing the southern end of the canyon) would increase to an ADT of 144, a 554% increase over existing conditions. During production activities, WTP project traffic at the Gate Canyon and Soldier Creek mine areas would result in ADTs of 267 and 89, respectively (a 242% increase in both instances; BLM 2010a)[1].

Gasco's contribution to traffic on the portions of the Nine Mile Canyon Backcountry Byway located below the canyon rim would only occur under Alternative C and would range to 1% to 6% of the current traffic condition (one to five vehicles per day). Above the rim, Gasco's project traffic would progressively increase towards the north end of the Nine Mile Canyon Backcountry Byway and would vary by alternative; however, there are no baseline traffic conditions against

[1] These traffic figures represent BBC's Proposed Action. Although the BLM ultimately selected reduced development, the ROD noted that transporation impactswould be similar to the Final EIS's Agency Preferred Alternative, which estimated impacts similar to the Proposed Action, although slightly lower during peak year development.

which to measure increases. Table 4-187 discloses the impacts from the Gasco and WTP projects on these three segments of the Nine Mile Canyon Backcountry Byway. Other development projects would also contribute to traffic increases along this road.

Table 4-187. Cumulative Impacts to Traffic on Nine Mile Canyon Backcounty Byway Above the Rim of Nine Mile Canyon from Gasco and the WTP

	Gate Canyon Road/ Wrinkle Road to Gate Canyon Upper Bench		Wells Draw Road/ Sand Wash Road to Wrinkle Road		Sand Wash Road/ Highway 40 to Wells Draw Road	
	Combined Project ADT	Gasco Contribution (%)	Combined Project ADT	Gasco Contribution (%)	Combined Project ADT	Gasco Contribution (%)
Alternative A	443	3%	550	22%	816	47%
Alternative B/E	442	2%	547	21%	806	47%
Alternative C	446	3%	606	29%	918	53%
Alternative D	432	<1%	457	9%	526	18%
Alternative F	442	2%	547	21%	782	45%

Traffic could also increase as a result of the WTP dust supression efforts and proposed road improvements, which would also improve road conditions in the area, possibly increasing tourism traffic or use for operators, employees, and suppliers who may have previously avoided the road due to poor conditions.

4.18.3.5 Livestock Management

The CIAA for impacts to livestock management is generally the area including all allotments that intersect the project area. However, cumulative impacts to livestock management are analyzed both across the entire Vernal FO planning area and at the individual allotment level, in order to quantify impacts both the resource in general and to grazing permittees who rely on particular allotments in the project area. A number of activities have impacted, and would continue to impact, livestock forage and allotments in the CIAA. The actions with adverse impacts (at least in the short-term) include most surface disturbing activities, including minerals and energy development, infrastructure development, expansion of the transportation network, and some vegetation treatments. However, cumulative effects from recreation, vegetation treatments, livestock management, and other mineral use (oil shale, tar sands, locatable minerals, and salable minerals) are difficult to quantify. Actions that result in the loss of vegetation may, depending on the amount of vegetation lost, adversely impact livestock grazing. Because not all forage is allocated for livestock, however, reduction of forage would not impact livestock grazing in all cases. Within grazing allotments in the BLM Vernal FO, there are currently approximately 10,094 existing wells, creating approximately 25,740 acres of surface disturbance. There are approximately 3,350 wells and approximately 8,200 acres of surface disturbance located in allotments that would also be affected by the Gasco project. Past development also includes surface disturbance to approximately 331 acres of the 4,795-acre stock drive trail.

Over the next 20 years, oil and gas development in the CIAA would remove or disturb 63,213 acres of vegetation resulting in the loss of forage that would therefore not be available for livestock grazing. Reasonably foreseeable oil and gas development projects would result in the lost of vegetation, and potentially AUMs, on allotments that are also within the Gasco project area, including the Programmtic EIS for tribal lands, BBC's West Tavaputs Plateau EIS, XTO's River Bend Unit Infill EIS, Newfields' Monument Buttes EIS and Exploratory Development Area (EDA) EA projects, and the Programmatic EIS for tribal Lands. Based upon the percentage of total project acres within these allotments, there would be approximately 16,817 acres of surface disturbance in allotments within the Gasco project area. Assuming 10 acres per AUM per allotment, this development would result in the loss of vegetation equal to approximately 1,625 AUMs. These projects would also impact approximately 591 acres of the 4,795-acre stock drive trail, 896 acres of which are within the Vernal plannning area.

Under the Proposed Action, construction of 1,491 wells and associated roads and other facilities would result in the disturbance of 7,511 acres. This amount of development would result in the loss of vegetation equal to approximately 740 AUMs, or 1.6% of the AUMs available in the affected allotments. Under Alternative B, 1,114 wells, associated roads, and other facilities would result in 5,642 acres of disturbance and 554 AUMs, or approximately 1.2% of available AUMs. Under Alternative C, 1,887 wells, associated roads, and other facilities would result in 9,930 acres of disturbance and 972 AUMs, or approximately 2.1% of available AUMs. Under the No Action Alternative, 368 wells, associated roads, and other facilities would result in 2,026 acres of disturbance and 200 AUMs, or approximately 0.4% of available AUMs. Under Alternative E, 1,114 wells, associated roads, and other facilities would result in 2,156 acres of disturbance and 219 AUMs, or approximately 0.5% of available AUMs. Under Alternative F, 1,298 wells, associated roads, and other facilities would result in 3,600 acres of disturbance and 369 AUMS, or approximately 0.8% of available AUMs. Vegetation, and AUMs, lost under the Proposed Action and alternatives would add cumulatively to AUMs lost from other oil and gas projects in the Gasco project area. See Table 4-188 below for information on forage (AUMs) lost by allotment. Impacts to the stock drive trail under the alternatives range from a loss of 0.5 acre to 27 acres. This would be 0.1% to 2.8% of the total cumulative acreage loss to the trail from all past and reasonably forseeable development.

Table 4-188. AUMs and Percentage of Total Forage Lost in Each Allotment

Grazing Allotment	AUMS Lost from Past and Reasonably Forseeable Projects	Other Projects + Gasco					
		Alternative A (Proposed Action	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Antelope Powers	887	889 (19.9%)	889 (19.9%)	908 (20.3%)	894 (20.0%)	887 (19.9%)	889 (19.9%)
Big Wash	2	32 (3.3%)	31 (3.2%)	63 (6.4%)	8 (0.8%)	12 (1.2%)	22 (2.2%0
Big Wash Draw	1	8 (1.6%)	8 (1.6%)	24 (4.7%)	5 (1.0%)	4 (0.8%)	5 (1.0%)
Bull Canyon	1	11 (1.1%)	7 (0.7%)	35 (3.5%)	3 (0.3%)	(0.3%)	8 (0.8%)
Castle Peak	485	570 (12.0%)	561 (11.8%)	658 (13.8%)	540 (1.3%)	513 (10.8)	521 (10.9%)
Currant Canyon	2	4 (0.9%)	3 (0.7%)	7 (1.6%)	2 (0.5%)	2 (0.5%)	3 (0.7%)
Devils Canyon	4	84 (3.1%)	32 (1.2%)	79 (2.9%)	13 (0.5%)	15 (0.6%)	56 (2.1%)
Eightmile Flat	532	585 (13.7%)	574 (13.5%)	617 (14.5%)	558 (13.1%)	564 (13.2%)	553 (13.0%)
Five Mile	3	91 (4.2%)	88 (4.1%)	112 (5.2%)	16 (0.7%)	36 (1.7%)	62 (2.9%)
Green River	93	93 (6.0%)	93 (6.0%)	93 (6.0%)	93 (6.0%)	93 (6.0%)	93 (0.9%)
Green River AMP	3	3 (0.5%)	3 (0.5%)	3 (0.5%)	3 (0.5%)	3 (0.5%)	3 (0.5%)
Green River Bottoms	0	2 (0.4%)	2 (0.4%)	4 (0.9%)	0 (0.0%)	1 (0.2%)	0 (0.0%)
Little Desert	85	290 (7.6%)	247 (6.5%)	289 (7.6%)	125 (3.3%)	142 (3.7%)	172 (4.5%)

Table 4-188. AUMs and Percentage of Total Forage Lost in Each Allotment

Grazing Allotment	AUMS Lost from Past and Reasonably Forseeable Projects	Other Projects + Gasco					
		Alternative A (Proposed Action	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Max Canyon	0	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Stone Cabin	29	29 (1.2%)	29 (1.2%)	29 (1.2%)	29 (1.2%)	29 (1.2%)	29 (1.2%)
Twin Knolls	4	63 (6.4%)	36 (3.6%)	50 (5.0%)	11 (1.1%)	16 (1.6%)	41 (4.1%)
Water Canyon 2	2	20 (5.5%)	16 (4.4%)	18 (5.0%)	4 (1.1%)	7 (1.9%)	12 (3.3%)
Wells Draw	44	79 (6.5%)	79 (6.5%)	91 (7.5)	56 (4.6%)	58 (4.8%)	67 (5.5%)
Wetlands	267	330 (19.8)	298 (17.9)	335 (20.1%)	284 (17.0%)	276 (16.6%)	276 (16.6%)
Total/Percentage of 46,048 AUMs within all Allotments	**2,809**	**3,548 (7.7%)**	**3,361 (7.3%)**	**3,780 (8.2%)**	**3,009 (6.5%)**	**3,026 (6.6%)**	**3,177 (6.9%)**

In addition to the loss of forage from vegetation removal, new road construction and increased travel on roads increases the risk of vehicle collisions with livestock. This risk currently exists along some portion of 14,374 miles of existing road in the BLM Vernal FO. Over the next 20 years, approximately 4,763 miles of new road would be constructed to support oil and gas development in the CIAA, and an additional 800 miles of motorized trails for backcountry recreational driving would be improved or constructed (BLM 2008c). The Proposed Action and alternatives would contribute 325 miles to that total. The alternatives would contribute between 72 and 526 miles of new road. It is assumed that with more roads, and greater levels of vehicle travel, the risk of collisions would increase.

Other actions would give emphasis to maintenance or restoration of livestock forage, and thus would be potentially beneficial to grazing. Forest and woodland treatments (on between 552,663 and 554,108 acres), vegetation treatments to enhance livestock forage (on between 34,640 and 50,900 acres), prescribed fire (on 312,850 acres), and vegetation restoration (on 200,000 acres) would result in surface and vegetation disturbance (BLM 2008c). While these actions would have the potential to reduce available forage in the short term, they would increase rangeland health and forage value in the long term. It should be noted that these different types of vegetation treatments would overlap in some areas, so the total acres of all lands treated cannot be added.

All of the land management agencies implement actions designed to maintain or increase forage levels for livestock grazing, including vegetation treatments, limits on numbers of allowed livestock, limits on plant utilization, construction of fences, construction of water sources, and use of grazing systems (e.g., rotation systems, seasons of use, etc.). These measures ensure continued availability of forage for livestock grazing.

4.18.3.6 PALEONTOLOGY

The CIAA for impacts to paleontological resources is the Vernal FO planning area. This CIAA accounts for impacts to paleontological resources that exist within the Uinta Basin and are collectively affected by ongoing resource management and energy extraction in this region. While the cumulative effects from recreation, vegetation treatments, livestock management, and other mineral use (oil shale, tar sands, locatable minerals and salable minerals) are difficult to quantify, natural gas production has the potential to adversely impact an unknown quantity of paleontological resources that may occur on or underneath the cumulative impact assessment area (CIAA). Past oil and gas exploration and development in the CIAA has disturbed 38,234 acres (see Table 4-154).

Reasonably foreseeable future actions include approximately 23,814 oil, gas, and coal-bed methane wells in the CIAA. Including the associated infrastructure, this would result in approximately 63,213 acres of surface disturbance (see Table 4-155.). The Proposed Action would contribute an additional 1,491 new wells and 7,584 acres of surface disturbance to the anticipated surface disturbance in the CIAA.

When paleontological monitoring and mitigation procedures are implemented prior to project construction, fossils are protected and information is gained. Also, planning actions that limit surface disturbance, like limiting OHV use, no surface occupancy leasing stipulations, and withdrawing lands from mineral entry all serve to protect fossils and prevent inadvertent damage. With monitoring and mitigation, the cumulative adverse impacts to fossils resulting from the

Proposed Action would be negligible. This would include conducting field surveys for surface fossils prior to ground-disturbing activities. This would provide the opportunity to recover any fossils found before ground disturbance occurs. In the event fossils are uncovered during construction, work would temporarily stop while qualified paleontologists excavate, record, and remove the discovery. Any scientifically significant fossils discovered would benefit the scientific community through an increase in knowledge associated with the fossils.

Alternative B would contribute 1,114 new wells and 5,685 acres of surface disturbance to the anticipated surface disturbance in the CIAA. Alternative C would contribute 1,887 new wells and 9,982 acres of surface disturbance to the anticipated surface disturbance in the CIAA. The No Action Alternative would contribute 368 new wells and 2,055 acres of surface disturbance to the anticipated surface disturbance in the CIAA. Alternative E would contribute 1,114 new wells and 2,174 acres of surface disturbance to the anticipated surface disturbance in the CIAA. Alternative F would contribute 1,298 new wells and 3,604 acres of surface disturbance to the anticipated surface disturbance in the CIAA. The cumulative impacts of Alternative B, C, D, E, and F would be the same as described for the Proposed Action, but to different degrees. Under Alternative B, D, E, and F, fewer acres would be disturbed, so the impacts described above to fossils would decrease. Under Alternative C, the acreage of surface disturbance would increase, as would the impacts to paleontological resource disclosed above.

4.18.3.7 Recreation

The CIAA for impacts to recreation is the BLM Vernal FO planning area. This CIAA encompasses an area of expanding mineral development managed under a common land use plan and generally accessed from the same communities. Cumulative impacts to cultural resources within Nine Mile Canyon are also addressed. Past and current actions have had both adverse and beneficial impacts on recreation in the CIAA. In some cases, the same action will affect different user groups differently. For instance, the construction of new travel routes has beneficially impacted OHV users and other recreationists though enhanced access, but have adversely impacted some non-motorized users through a loss of opportunity for primitive activities and experiences. There are currently at least 4,861 miles of designated motorized routes in the CIAA (BLM 2008b). In addition, 14,941 existing and abandoned wells in the CIAA have affected the recreation setting and various users' desired experience, particularly opportunities for primitive recreation (Table 4-154).

Development of energy resources in the CIAA has changed and would continue to change recreation opportunities—activities, settings, experiences, and benefits. With the development of roads, well pads, pipelines, compressor stations, and other related infrastructure, the recreational setting would change to a more roaded, developed, and somewhat industrial setting. Reasonably foreseeable future actions include an anticipated 4,763 miles of road and 63,213 acres of surface disturbance.

Current and foreseeable actions other than oil and gas development would also impact recreation opportunities. Forest and vegetation treatments, limitations on livestock grazing in riparian zones, and requirements for erosion control plans would all enhance vegetation condition, wildlife habitat, and water quality. This would enhance opportunities for fishing, hunting, and wildlife viewing. Improvement and development of up to 400 miles of trails for hiking, mountain biking, and horseback riding would enhance those recreational activities. Improvement and development of up to 800 miles of motorized trails for backcountry recreational driving would enhance opportunities for both backcountry driving and mountain biking (BLM 2008b). Limiting OHV driving to designated routes would provide that opportunity while preventing further disturbance to soil, vegetation, and water and conflicts with other non-motorized recreation users. And, limits on human disturbances around raptor nests and in deer migration corridors, and reclamation requirements in deer and elk winter range would protect wildlife populations and provide continued opportunities for both hunting and wildlife viewing.

The Proposed Action would add 325 miles of new road and 7,584 acres of surface disturbance to the totals above. This development would contribute to shifting recreation opportunities toward those activities that use motorized vehicles. Alternative B would add 274 miles of new road and 5,685 acres of surface disturbance. Alternative C would add 526 miles of new road and 9,982 acres of disturbance. The No Action Alternative would contribute 72 miles of new road and 2,055 acres of surface disturbance. Alternative E would add 106 miles of new road and 2,174 acres of disturbance. Alternative F would add 198 miles of new road and 3,604 acres of disturbance. Although the amounts of road and acreages of surface disturbance vary under each of the alternatives, their effect on the recreation opportunities—activities, settings, experiences, and benefits—would be that same as described above, but to different degrees.

There are currently approximately 14,374 miles of road in the BLM Vernal FO. Development of natural gas would expand motorized access to previously unroaded areas, such as Nine Mile Canyon and the Lower Green River, providing further opportunities for backcountry driving, vehicle-supported camping and picnicking, wood cutting, hunting, and interpretation of natural resources. See Section 4.11, Special Designations, for additional analysis of specific cumulative impacts to the Nine Mile Canyon and Lower Green River areas. It would also, however, reduce opportunities for primitive forms of recreation that require a more natural and undeveloped setting. These opportunities include such activities as hiking and mountain biking on trails, backpacking, river floating, hunting, nature study, and wildlife viewing.

Dust supression efforts and proposed road improvements on Nine Mile Canyon Road are expected as a result of the WTP development (BLM 2010a). A decrease in dust and improved road conditions could enhance visitor experience in the canyon; however, this may also result in an increase in overall visitation, which could diminish the backcountry experience and lead to potential conflicts with recreational users and industry-related traffic. A 554% increase in traffic is projected during the WTP peak development, and a 242% increase during production.

Under the Proposed Action, natural gas development would not contribute to cumulative impacts to recreational resources below the rim of Nine Mile Canyon, but would add approximately 1,940 acres of surface disturbance (and associated impacts, including noise and increased travel) within the Nine Mile Canyon SRCMA (see Table 4-186). This would equate to 73% of the total cumulative disturbance within the SRCMA (Table 4-186). Under Alternative B, 912 acres would be disturbed within the SRCMA, with 2% occurring below the canyon rim. This would equate to 56% of the total cumulative disturbance within the SRCMA. Under Alternative C, 2,040 acres would be disturbed within the SRCMA, with 28% occurring below the canyon rim. This would equate to 74% of the total cumulative disturbance within the SRCMA. Under the No Action Alternative, 235 acres would be disturbed within the SRCMA, with 0% occurring below the canyon rim. This would equate to 70% of the total cumulative disturbance within the SRCMA. Under Alternative E, 348 acres would be disturbed within the SRCMA, with 3% occurring below the canyon rim. This would equate to 70% of the total cumulative disturbance within the

SRCMA. Under Alternative F, 924 acres would be disturbed within the SRCMA, with 0% occurring below the canyon rim. This would equate to 56% of the total cumulative disturbance within the SRCMA.

4.18.3.8 Socioeconomics and Environmental Justice

The CIAA for impacts to recreation is the BLM Vernal FO planning area. This CIAA encompasses an area of expanding mineral development drawing that generally draws on same communities for workers, services, and housing. Past and present increases in energy development in the CIAA have led to numerous socioeconomic impacts within the CIAA. Both the number of jobs and average personal income has grown over the last decade in the CIAA (UDWS 2008 and UDWS 2005b). This growth has led to a housing shortage in the CIAA, and increased personnel demand in some employment sectors (UDWS 2006). As of October 2011, there were 14,941 wells in the CIAA (see Table 4-154). This total includes oil, natural gas, and coal-bed methane wells, and producing, shut-in, service, plugged, and temporarily abandoned wells.

Over the next 20 years, 23,814 oil and natural gas wells are expected to be drilled throughout the CIAA. Based on a workforce requirement of 1,644 worker days per well, this would generate employment for approximately 3,573 well drillers. Based on a workforce requirement of 1,644 worker days per well, drilling 1,491 gas wells under the Proposed Action would create employment for an additional 224 people for the life of the project, or approximately 6% of total projected oil and gas drilling jobs in the CIAA. In addition to the well drilling jobs, jobs in the mining trade, construction, and service industries would also increase in the CIAA. Based on the same workforce requirement of 1,644 worker days to drill a well, drilling between 368 and 1,887 wells under Alternative B through F would create employment for between 56 and 257 additional people, between 2% and 7% of the total projected well-drilling jobs in the CIAA.

Because the counties in the CIAA have resource-based economies, the current and foreseeable oil and gas development would contribute to population growth in the CIAA. The growth is expected to be comparable to the number of oil and gas wells that would be drilled. However, the largest increases would occur in the initial construction phase, and taper off as wells move into the production phase. The Proposed Action and alternatives would contribute proportionately to population growth in the communities of the CIAA.

The increase in population resulting from the accumulated oil and gas development would generate a proportionate increase in the need for additional social services and infrastructure in the CIAA. The population increases resulting from the Proposed Action and alternatives would result in proportionate increases in crime, fire, and demands for community services in the entire CIAA.

According the UEO (2004), drilling and completion of a single gas well would result in $28,200 in net local revenue over the life of the well. Assuming the same revenue would be generated for oil and gas wells, the anticipated 23,814 oil and gas wells expected to be drilled in the CIAA over the next 20 years, would generate $671,554,800 in local net revenue. The Proposed Action and alternatives (between 368 and 1,887 wells) would contribute an additional $10,377,600 to $53,213,400, depending on the alternative selected, or between 2% and 7% of the total projected net revenue in the CIAA.

The current supply of housing in the CIAA is not satisfactory to meet demand for oil and gas workers during periods of "booming" oil and gas development. The 227 employees needed to implement the Proposed Action would contribute to the housing shortfall if development occurred during boom times, likely adding to the need for multiple-family, short-term housing units like apartments and mobile homes, rather than single-family homes intended for a more long-term population. Because Alternatives B, E, and F would create fewer jobs (170 and 195 new jobs, respectively) than the Proposed Action, there would be a proportionate reduction in demand for housing and difficulties finding housing under these alternatives. Alternative C would create the most new jobs (257 new jobs), and the resulting demand for housing would also increase. The No Action Alternative would create only 56 new jobs, far fewer than the Proposed Action or the other alternatives. As a result, the demand for housing would be less than the Proposed Action or the other alternatives.

The Proposed Action and its alternatives would result in a 1.2% to 6.2% increase over 2009 average daily traffic volume on Highway 40 near Myton, Utah. Traffic associated with the anticipated 23,814 oil and gas wells expected to be drilled in the CIAA over the next 20 years would also contribute to this increase, particularly during the development phases. The WTP project alone is expected to result in an increase of 4% to 9% on these sections, 30% due to heavy trucks. Proposed road improvements to Nine Mile Canyon Road as a result of the WTP project could result in changes in worker residence patterns, as commutes from Price or other areas via Nine Mile Canyon road become safer and shorter.

Employees requiring short-term housing during boom times in oil and gas development have dominated hotel and RV park availability in the CIAA, and competing with that availability for travel and tourism. Jobs needed to implement the Proposed Action and alternatives would contribute to this shortfall should development occur during boom times, further limiting growth of the tourism industry, including tourism-related jobs, income, and revenue to local government. In recent years, the impacts of reduced tourism, however, were offset by growth in the oil and gas industry, though that trend has changed as oil and gas development has decreased within the last five years.

Within the BLM Vernal FO planning area, the Fort Duchesne, Randlett, and Whiterocks CDPs and the City of Myton meet the criteria established for consideration as an "EJ population." Increases in project-related vehicle traffic would not go directly through the EJ communities of Myton, Randlett, Fort Duchesne, and Whiterocks, but would contribute to an overall increase in traffic on Highway 40.

4.18.3.9 Soils

The CIAA for impacts to soils is the Vernal FO planning area. This CIAA accounts for impacts to soils that are collectively affected by ongoing resource management and energy extraction in this region, and are generally managed under a common land use plan. Past oil and gas exploration and development in the CIAA has resulted in 38,234 acres of long-term disturbance to soils. Surface disturbing activities impact soils to varying degrees, depending on the amount, placement, and type of surface disturbance, the type of soil and its characteristics, and the surface hydrology. Specific impacts to soils include removal of vegetation, exposure of soil, mixing of soil horizons (layers), soil compaction, loss of productivity, and increased susceptibility to wind and water erosion. Other surface-disturbing activities, such as livestock grazing, OHV driving, and vegetation treatments have also impacted soil over an unknown portion of the CIAA. The cumulative effects from recreation, vegetation treatments, livestock management, and other mineral use (oil shale, tar sands, locatable minerals, and salable minerals) are difficult to quantify.

Reasonably foreseeable future actions and development would create surface disturbances that would have similar impacts to soils as the past impacts described above. Construction of an anticipated 23,814 oil and gas wells would result in 63,213 acres of surface disturbance. Forest and woodland treatments (on up to 546,152 acres), vegetation treatments to enhance livestock forage (on between 34,640 and 50,900 acres), prescribed fire (on 312,850 acres), and vegetation restoration (on 200,000 acres) would result in surface disturbance (BLM 2008b). These actions would have the same potential for disturbance to soils as described above. It should be noted, however, that these different types of vegetation treatments would likely overlap, and the total acres of all lands treated cannot be added.

There are 14,374 miles of existing roads in the CIAA. Improvement and new construction of 400 miles of non-motorized trails, and improvement and construction of 800 miles of motorized trails for backcountry recreational driving would result in approximately 1,439 acres of surface disturbance, provide continued and expanded human access to public lands, and would increase the risk of unauthorized cross country OHV travel (BLM 2008b).

The Proposed Action would disturb an additional 7,584 acres of soils and increase the road network by 325 miles over the next 45 years, resulting in a proportionate contribution to the impacts described above. Alternative B would disturb an additional 5,685 acres of soils, including 274 miles of new road. Alternative C would disturb an additional 9,982 acres of soils, including 526 miles of new road. The No Action Alternative would disturb an additional 2,055 acres of soils, including 72 miles of new road. Alternative E would disturb an additional 2,174 acres of soils, including 106 miles of new road. Alternative F would disturb an additional 3,604 acres of soils, including 198 miles of new road. The impacts of Alternative B, C, D, E, and F on soils would be the same as for the Proposed Action described above, just with varying degrees based on increases and decreases in surface disturbances.

The Proposed Action would also contribute cumulatively to activities that disrupt sensitive soil communities, including biological soil crusts. Under the Proposed Action, surface disturbance would occur in 3,028 acres of sagebrush vegetation communities and 1,143 acres of pinyon-juniper woodland communities, both plant communities associated with biological soil crusts. Because biological soil crust communities recolonize and regrow very slowly when disturbed, the soil stabilization, nitrogen fixing, and carbon-fixing benefits of soil crusts would be lost for up to 250 years. Under Alternative B surface disturbance would occur in 2,123 acres of sagebrush communities and 974 acres of pinyon-juniper woodland communities. Under Alternative C surface disturbance would occur in 3,535 acres of sagebrush communities and 1,717 acres of pinyon-juniper woodland communities. Under the No Action Alternative surface disturbance would occur in 652 acres of sagebrush communities and 278 acres of pinyon-juniper woodland communities. Under Alternative E surface disturbance would occur in 776 acres of sagebrush communities and 126 acres of pinyon-juniper woodland communities. Under Alternative F surface disturbance would occur in 1,509 acres of sagebrush communities and 576 acres of pinyon-juniper woodland communities. The cumulative impacts to biological soil crusts under Alternative B, C, D, E, and F would be the same as described for the Proposed Action, but to varying degrees based on projected acres of disturbance.

4.18.3.10 Special Designations

The CIAA for impacts to special designations is defined as the specially designated area itself. ACECs are areas of public land that require some type of special management attention to protect or prevent irreparable damage to important historic, cultural, or scenic values, fish and wildlife resources, or other natural systems or processes, or to protect life and safety from natural hazards. ACECs are individual, and their values vary from place to place. ACEC values often include biological values (wildlife, vegetation, water, soil), scenic values, cultural resources (historic or prehistoric), geologic features, and natural hazards. This section discloses the cumulative impacts of past, present, and reasonably foreseeable actions on the ACEC values present in the Gasco project area. However, for an ACEC with other values such as wildlife, an assessment of cumulative impacts to these values may also be found in Section 4.16, Wildlife, of this analysis.

Similarly, for a river corridor to be eligible for consideration as a wild and scenic river, it must possess one or more outstandingly remarkable values. Those values are also natural and cultural resource-related, and the disclosure of cumulative impacts to outstandingly remarkable Wild and Scenic River values may also be found in other appropriate sections of this analysis.

Past oil and gas exploration resulted in 38,234 acres of long term disturbance in the BLM Vernal FO planning area (BLM 2008b). Development of oil and gas typically includes construction of roads, well pads, pipelines, power lines, compressors, and other facilities. Development of this type has created surface disturbance and altered the land, but has not eliminated the relevant and important ACEC values of Pariette Wetlands ACEC (riparian, wetland, and special status species values), Lower Green River ACEC (visual and special status species values), Nine Mile Canyon ACEC (cultural resources, scenery, special status species, and wildlife habitat values), or the suitable Lower Green River Wild and Scenic River (scenery and recreation values).

Other land uses have resulted in an unknown acreage of surface-disturbing activities, such as livestock grazing and OHV driving. But, construction of livestock facilities (e.g., fences and waters) and backcountry OHV driving have not eliminated the ACEC or Wild and Scenic River values of these special management areas.

Reasonably foreseeable actions and development would create surface disturbances that would have similar impacts to special management areas, as described above. Reasonable foreseeable actions include other oil and gas projects that fall within ACECs overlapping the Gasco project area, including the BBC West Tavaputs Plateau EIS, Newfield EDA EA, Newfield Monument Butte EIS, and Programmatic EIS for Tribal Lands (Table 4-153). These projects would result in some degree of surface disturbance in all of the special management areas. Table 4-189 shows the cumulative surface disturbance that would occur in each of the special designation areas from this reasonably foreseeable well development and well development under the Proposed Action and alternatives.

Surface disturbance in each of the special designation areas, however, does not necessarily result in adverse impacts to the identified relevant and important ACEC values or the outstandingly remarkable Wild and Scenic River values. BLM policy requires protection of the values that make these places eligible for consideration as ACEC and WSRs, subject to valid existing rights, and gas well development is not necessarily precluded. Although some surface disturbance would occur in each special designation area under each alternative, eligibility for designation as an ACEC or Wild and Scenic River would be maintained.

Table 4-189. Surface Disturbance (Acres) by Special Designation Area

Special Designation Area	Past Oil and Gas Projects in ACEC	Other Foreseeable Oil and Gas Projects in ACEC	Other Projects + Gasco					
			Alternative A (Proposed Action)	Alternative B (Reduced)	Alternative C (Full)	Alternative D (No Action)	Alternative E (Directional)	Alternative F (Agency Preferred)
Pariette Wetlands ACEC	326	1386	1,786	1714	1738	1715	1712	326
Lower Green River ACEC	18	71	134	127	112	106	102	18
Nine Mile Canyon ACEC	66	1	911	377	1253	172	187	497
Lower Green WSR—suitable	13	53	153	148	128	117	106	13

Note: Reasonably foreseeable oil and gas projects included in this analysis: BBC West Tavaputs Plateau EIS, Newfield EDA EA, Newfield Monument Butte EIS, Programmatic EIS for Tribal Lands and XTO River Bend Unit Infill EA. Surface disturbance within area of special designation for WTP is based on the WTP (ROD 2010). Surface disturbance for the other projects is based on on percentage of project within the special designation area (see Table 4-155 for project and surface disturbance acreage totals).

Other actions would be implemented that would cumulatively protect ACEC values of Pariette Wetlands, Nine Mile Canyon, Coyote Basin-Myton Bench, and the Lower Green River and the Wild and Scenic River values along the Lower Green River. The prescription for protection of the ACEC values includes VRM objectives that retain the character of the landscape (Class II), limits on OHV use to designated routes, and a recommendation to withdraw the Lower Green River ACEC from mineral entry. Further, all of the Pariette Wetlands and Lower Green River ACECs and the Nine Mile Canyon ACEC within the canyon would be managed as no surface occupancy for oil and gas development to protect relevant and important values.

4.18.3.11 Special Status Species

The CIAA for impacts to special status species is the Vernal FO planning area. This CIAA accounts for impacts to special status species that are collectively affected by ongoing resource management and energy extraction in this region, and are generally managed under a common land use plan. Direct impacts to special status species include an increased risk of mortality; disturbance of habitat (occupied or suitable); disturbance from the noise and presence of OHVs; habitat fragmentation; disruption of wildlife migration, activity patterns and timing, and plant seed dispersal and pollination; disruption of wildlife breeding, nesting, and roosting due to construction, drilling, and other human activities; reduction of water quality and quantity in fish habitat due to flow depletion; and an increased chance of sedimentation of waterways, or contamination of the Upper Colorado River drainage system by accidental spillage of oil and gas products.

There are currently approximately 14,374 miles of road in the Vernal FO. Past and present oil and gas exploration and development in the CIAA has disturbed 38,234 acres of land, some portion of which contains special status species habitat (see Table 4-154). Reasonably foreseeable actions and development would create surface disturbances that would have similar impacts on special status species and their habitat as described above. Construction of an anticipated 23,814 oil and gas wells and 4,763 miles of associated roads would result in 63,213 acres of surface disturbance, which could include special status species habitat (see Table 4-155.).

Continued travel along 4,861 miles of designated motorized routes, improvement and construction of 400 miles of non-motorized trails, and improvement and construction of 800 miles of motorized trails for backcountry recreational driving would provide continued and expanded human access to public lands with impacts to special status species similar to those described above. However, limiting motorized travel to designated routes would reduce those impacts, as compared to cross country travel.

Forest and woodland treatments (on up to 546,152 acres), vegetation treatments to enhance livestock forage (on between 34,640 and 50,900 acres), prescribed fire (on 312,850 acres), and vegetation restoration projects (on 200,000 acres) would result in surface and vegetation disturbance (BLM 2008b). The surface disturbance created by these land and vegetation treatments would have impacts to special status species and their habitat similar to those described above. It should be noted, however, that these different types of vegetation treatments would likely overlap, and the total acres of all lands treated cannot be added.

Other actions are anticipated, however, that would protect or benefit special status species and their habitat. Grazing would be limited in riparian systems to maintain and achieve proper functioning condition within 0.25 mile year-round and within 2 miles of active Greater sage-grouse leks during breeding season (March 1–June 15) to ensure successful reproduction. No permanent facilities or structures would be constructed within 2 miles of a lek whenever possible. Measures would be taken to limit noise within 0.5 mile of leks. And surface disturbance and occupancy buffers would be established around raptor nests during breeding seasons. These actions would cumulatively benefit special status wildlife species and their habitat. Integration of and adherence to the BLM and USFWS–developed avoidance and minimization measures and the development of core conservation areas for federally threatened, endangered, or candidate plant species would cumulatively benefit special status plant species and their habitat.

Under the Proposed Action, development of 1,491 natural gas wells would cumulatively contribute an additional 7,584 acres of surface disturbance, including 325 miles of new roads to the anticipated reasonably foreseeable development of the CIAA. Thus, the Gasco development would add cumulatively to the overall impact of energy development to special status species and their habitat in the CIAA as described above. Under Alternative B development of 1,114 new wells and 274 miles of new roads would result in an additional surface disturbance of 5,685 acres. Under Alternative C development of 1,887 new wells and 526 miles of new roads would result in an additional surface disturbance of 9,982 acres. Under the No Action Alternative, development of 368 new wells and 72 miles of new roads would result in an additional surface disturbance of 2,055 acres. Under Alternative E development of 1,114 new wells and 106 miles of new roads would result in an additional surface disturbance of 2,174 acres. Under Alternative F, development of 1,298 new wells and 198 miles of new roads would result in an additional surface disturbance of 3,604 acres. Development under Alternatives B, C, D, E, and F would cumulatively contribute the same kinds of impacts on special status species as described for the Proposed Action, but to varying degrees, based on differences in amount of surface disturbance and miles of new roads.

4.18.3.12 VEGETATION

The CIAA for impacts to vegetation is the Vernal FO planning area. This CIAA accounts for impacts to vegetation that is collectively affected by ongoing resource management and energy extraction in this region, and is generally managed under a common land use plan. Vegetation is removed by surface disturbing activities such as construction of roads, well pads, pipelines, power lines, compressor stations, water facilities, and other ancillary facilities. Other activities, such as livestock grazing, cross country OHV driving, vegetation treatments, fire (wild and prescribed), and construction of utilities, waters, and recreation sites have also resulted in the disturbance or removal of vegetation. The risk of weed invasion is greatest within 200 feet of roads.

There are currently approximately 14,374 miles of road in the BLM Vernal FO. Past oil and gas exploration in the CIAA has disturbed 38,234 acres of land, including vegetation (see Table 4-154). Reasonably foreseeable future actions and development would create surface disturbances that would have similar impacts to vegetation as the impacts described above. Construction of an anticipated 23,814 oil and gas wells, and associated 4,763 miles of roads would result in 63,213 acres of surface, and vegetation disturbance. Thus, 230,933 acres have the greatest risk of invasion by weeds.

Forest and woodland treatments (on up to 546,152 acres), vegetation treatments to enhance livestock forage (on between 34,640 and 50,900 acres), prescribed fire (on 312,850 acres), and vegetation restoration projects (on 200,000 acres) would result in surface and vegetation disturbance (BLM 2008b). These treatments would, in the short term, disturb and remove vegetation. In the long term, however, these actions would maintain and improve vegetation condition for a variety of resource objectives. It should be noted, however, that some of these different types of vegetation treatments would likely overlap, and the total acres of all lands treated cannot be added.

Future improvement and construction of 400 miles of non-motorized trails, and improvement and construction of 800 miles of motorized trails for backcountry recreational driving would result in the removal of 291 acres and 1,148 acres of vegetation, respectively. Continued motorized (OHV) travel along between 4,860 miles of existing routes and 800 miles of additional motorized trail could result in the introduction of noxious weeds to native vegetation communities (BLM 2008b). At the same time, however, limiting backcountry driving to designated routes (eliminating nearly all cross country driving) would protect native vegetation communities and help prevent the spread of noxious weeds.

Other reasonably foreseeable actions would impact vegetation, including livestock grazing and soil erosion measures. Requiring approved erosion control plans for surface disturbing activities on slopes between 21% and 40% would protect soils that support vegetation. Limiting livestock forage utilization to proper levels would ensure continued rangeland health and the desired composition in vegetation communities. Cumulatively, these actions would benefit native and desired vegetation communities.

Under the Proposed Action, natural gas development would cumulatively contribute 7,584 additional acres of surface, and thus vegetation disturbance in the CIAA. Because the risk of noxious weed invasion is greatest within 200 feet of roads, the Proposed Action would put 15,757 acres at risk to noxious weed invasion along 325 miles of new roads. Under Alternative B, well development would cumulatively contribute 5,685 additional acres of surface and vegetation disturbance. Vegetation disturbance along 274 miles of new road would put 13,285 acres at risk for weed invasion. Under Alternative C, well development would cumulatively contribute 9,982 additional acres of surface and vegetation disturbance. Vegetation disturbance along 526 additional miles of new road would put 25,503 acres at risk for weed invasion. Under the No Action Alternative, well development would cumulatively contribute 2,055 additional acres of surface and vegetation disturbance. Vegetation disturbance along 72 miles of new road would put 3,491 additional acres at risk for weed invasion. Under Alternative E, well development would cumulatively contribute 2,174 additional acres of surface and vegetation disturbance. Vegetation disturbance along 106 miles of new road would put 5,139 acres at risk for weed invasion. Under Alternative F, well development would cumulatively contribute 3,604 additional acres of surface and vegetation disturbance. Vegetation disturbance along 198 miles of new road would put 9,600 acres at risk for weed invasion.

Although the life of the Gasco project is estimated to be approximately 45 years, the life of a producing well is projected to be 30 years. As wells go out of production, the roads, well pads, and some associated facilities would be rehabilitated, reestablishing the desired plant communities. Depending on the vegetation type, reclamation would be accomplished within 10 years. Thus, the Gasco development would add cumulatively to the overall impact of energy development on vegetation resources in the CIAA.

4.18.3.13 Visual Resources

The CIAA for impacts to visual resources is the Vernal FO planning area. This CIAA accounts for impacts to visual resources that are collectively affected by ongoing resource management and energy extraction in this region, and are generally managed under a common land use plan. Development of oil and gas typically includes construction of roads, well pads, pipelines, power lines, compressors, and other facilities. Development to this degree has transformed the land to a more roaded, developed, and somewhat industrial landscape. Depending on the landform, vegetation type, and well spacing, the surface disturbance and production facilities are evident to varying degrees. In some areas the development dominates the landscape. In others, the traditional landscape remains evident, even with development. Development associated with oil and gas activities, or other similar surface disturbing activities, are consistent with VRM Class III and IV management objectives. Surface disturbing activities on lands with VRM Class II objectives may not be consistent with those objectives. Disturbances would have to be mitigated to a level where they would not attract the attention of a casual observer, unless they are associated with pre-RMP leases, in which case the lease would be a valid pre-existing contractual right that would not be subject to visual objectives.

Past oil and gas exploration has disturbed 38,234 acres of land in the CIAA (BLM 2008b). Other public land uses have resulted in an unknown acreage of surface-disturbing activities, such as livestock grazing, OHV driving, and vegetation treatments, and have also affected the character of the landscape. Construction of livestock facilities (e.g., fences and waters) and wildlife waters, cross-country OHV driving, and vegetation treatments (e.g., chainings), have also altered the existing character of the landscape with changes in vegetation pattern and the introduction of human-made features on the land.

Reasonably foreseeable future actions include the construction of 23,814 gas, oil, and coal-bed methane wells (BLM 2004b), including the construction of well pads, pipelines, power lines, compressors, and 4,763 miles of roads. These facilities would disturb approximately 63,213 acres of soil and vegetation. For those wells that go into production, they will be evident on the land as described above. Those wells that are dry would be reclaimed.

Forest and woodland treatments (on up to 546,152 acres), vegetation treatments to enhance livestock forage (on between 34,640 and 50,900 acres), prescribed fires (on 312,850 acres), and vegetation restoration projects (on 200,000 acres) would result in surface and vegetation disturbance (BLM 2008b). In the short term, these actions would have the same potential for disturbance to visual resources as described above. In the long term, however, fire and vegetation treatments have the potential to introduce vegetative variety to the landscape, which often creates visual interest and appeal. It should be noted that these different types of vegetation treatments would likely overlap, and the total acres of all lands treated cannot be added.

Improvement and construction of 400 miles of non-motorized trails, and improvement and construction of 800 miles of motorized trails for backcountry recreational driving would disturb approximately 291 and 1,148 acres of soils and vegetation, respectively, introducing linear features to the landscape. Given the size and nature of these developments, the impacts would be similar to those described above, but to a lesser degree. Other actions are anticipated that would impact the characteristic landscape, including construction of roads, livestock facilities, wildlife guzzlers, utility lines, and other mineral operations. This construction would also produce a more developed landscape, much as described for oil and gas development above, but to a lesser degree and scale.

Under the Proposed Action, development of 1,491 natural gas wells would cumulatively contribute 7,584 additional acres of surface disturbance, including 325 miles of new roads, to future changes in the landscape. The Gasco development would add cumulatively to the landscape changes resulting from human development in the CIAA. Under Alternative B, 1,114 new wells and 274 miles of new road would result in 5,685 additional acres of surface disturbance to the characteristic landscape. Under Alternative C, 1,887 new wells and 526 miles of new road would result in 9,982 additional acres of surface disturbance to the characteristic landscape. Under the No Action Alternative, 368 new wells and 72 miles of new road would result in 2,055 additional acres of surface disturbance to the characteristic landscape. Under Alternative E, 1,114 new wells and 106 miles of new road would result in 2,174 additional acres of surface disturbance to the characteristic landscape. Under Alternative F, 1,298 new wells and 198 miles of new road would result in 3,604 additional acres of surface disturbance to the characteristic landscape. The impacts to the landscape, and visual resources, under Alternatives B, C, D, E, and F would be the same as for the Proposed Action described above. Variations in the amount of surface disturbance, road construction, and placement of facilities under the alternatives would create differences between the alternatives, but the cumulative effects would be similar under all alternatives.

4.18.3.14 WATER RESOURCES

The CIAA for impacts to water resources is the Vernal FO planning area. This CIAA accounts for impacts to water resources that are collectively affected by ongoing resource management and energy extraction in this region, and are generally managed under a common land use plan. Development of oil and gas typically includes construction of roads, well pads, pipelines, power lines, compressors, and other facilities. These activities create surface disturbances that can result in soil erosion, increased water runoff, landslides, flooding, and subsequent water quality degradation. Direct and indirect impacts to water resources include groundwater depletion; surface water depletion; degradation of surface water from condensate spills; degradation of surface water from sedimentation, turbidity, salinity, and selenium; and loss of proper functioning condition of riparian and wetland areas and floodplains. Water quality could also be impacted by hazardous material spills and disposal of wastewater. No impacts to fresh_water aquifers would be expected, because well holes would be cased. Other land uses have resulted in an unknown acreage of surface disturbing activities.

4.18.3.14.1 CUMULATIVE IMPACTS TO FRESH WATER AQUIFERS

Additional drilling activities are reasonably foreseeable in the project area and could result in cumulative impacts to fresh water resources. Based on available data, fresh water resources are relatively shallow and of limited extent in the project area; however, if present they can potentially be impacted by drilling activities, disposal in evaporative ponds, and fracturing activities.

Drilling techniques are designed to isolate the upper 200 feet of formation using a surface casing. The available water quality data suggest that this zone would be the location of any fresh water resources.

According to the Utah Department of Water Resources (UDWaR) (1999), there is 31 million acre-feet of water in the Uinta Basin's aquifers, mostly in the upper 100 feet of saturated material. None of this water would be used for drilling, completion, or production. These activities would, however, result in the permanent withdrawal of groundwater-produced formation water. Because at least some of this water would be evaporated rather than reinjected under the Gasco alternatives, these depletions would decrease, over the long term, the amount of water stored in these aquifers by approximately 5,015 to 25,715 acre-feet over the 45-year life of the Gasco project. This is approximately 0.02 to 0.08% of the estimated 31 million acre-feet of water stored in the Uinta Basin (UDWaR 1999). Assuming that the approximately 23,814 reasonably foreseeable wells would use the same amount of produced water as the Gasco project, an additional approximately 811,310 acre feet would be depleted, or approximately 2.62% of the 31 million acre feet of water in the basin.

Disposal ponds are unlikely to be located in areas where fresh water resources exist based on the UDOGM permitting requirements; engineering controls such as liners and leak detection further reduce the risk of impact to fresh water resources from evaporative disposal ponds.

Hydraulic fracturing is less easy to control than drilling and evaporation ponds. However, a low-toxicity fracturing fluid would be used and would be nearly 100% recovered following fracturing, with only minor amounts remaining in aquifer pore space, representing minimal risk of migration of fracturing fluid into the aquifer. The resulting fractures will be isolated from potential fresh water resources by 4,000–5,000 vertical feet of separation; available data suggest fractures are unlikely to propagate a fraction of this distance.

Aside from other drilling activities, no other reasonably foreseeable activities have been identified that would directly or indirectly impact shallow fresh water aquifers. Cumulative impacts to shallow fresh water aquifers from reasonably foreseeable drilling activities are expected to be minimal.

4.18.3.14.2 Cumulative Impacts to Surface Waters

There are currently approximately 14,374 miles of road in the BLM Vernal FO. Past oil and gas exploration has disturbed 38,234 acres of land in the CIAA. Reasonably foreseeable future actions include drilling 23,814 gas, oil, and coal-bed methane wells, including the construction of well pads, pipelines, power lines, compressors, and 4,763 miles of roads (see Table 4-155.). These facilities would disturb approximately 63,213 acres of soil and vegetation, with impact to water similar to those described above.

Assuming an average of 2.5 acre-feet of surface water would be required for drilling, completion and production of a single well, assuming this water would be obtained from surface waters of the CIAA, and assuming a project life of 45 years (the time required from drilling the first well to drilling the last well, and a production life of 30 years per well), 23,814 wells would require 59,535 acre-feet of water over the life of the project, or 1,323 acre feet per year. If this water would eventually have reached the Green River, which has an average annual flow of over 4 million acre-feet, this represents an annual depletion of approximately 0.033% from the Green River.

It is expected that surface waters in the CIAA would experience increased sedimentation resulting from erosion from oil and gas activities. Using the erosion and sediment yield assumptions identified in Section 4.10.1.1.3, 23,814 wells would produce 8,618,287 tons of sediment over 34 years. Assuming 20% of this sediment reached the Green River, which has an annual sediment load of 9,684,000 tons, this represents approximately 0.52% of the sediment delivered to the Green River each year.

Forest and woodland treatments (on up to 546,152 acres), vegetation treatments to enhance livestock forage (on between 34,640 and 50,900 acres), prescribed fires (on 312,850 acres) and vegetation restoration projects (on 200,000 acres) would result in surface disturbance (BLM 2008b). In the short term, these actions would have the same potential to impact water quality as described above. In the long term, however, maintenance and enhancement of healthy vegetation communities would benefit both water quality and quantity. Healthy upland and riparian vegetation communities slow water flow, enhance infiltration, and reduce sedimentation, improving both water quality and quantity. It should be noted that these different types of vegetation treatments would likely overlap, and the total acres of all lands treated cannot be added.

Improvement and construction of 400 miles of non-motorized trails, and improvement and construction of 800 miles of motorized trails for backcountry recreational driving would disturb approximately 1,439 acres of soils and vegetation with similar impacts to water as described above. Use of these routes would lead to some increased level of soil erosion, increased overland water flow, and reduce water quality in perennial streams, rivers, and wetlands of the CIAA.

The road improvements in Nine Mile Canyon Backcountry Byway proposed as part of the WTP could negatively impact water resources through increased runoff from pavement, but also positively impact these resources through a decreased level of soil erosion, and potential reduction in the use of dust suppressants (BLM 2010a).

The proposal to withdraw the Lower Green River from mineral entry would prevent surface disturbances that cause sedimentation, maintaining water quality. Putting limits on livestock forage utilization in riparian zones would protect vegetation needed to capture sediments, slow flows, enhance infiltration, improve water quality, and maintain function of the riparian community. Requiring approved erosion control plans for surface-disturbing activities on slopes between 21% and 40% would reduce erosion and sediment loads in the rivers, streams, and wetlands of the CIAA. Prohibiting surface disturbance on slopes over 40% would also reduce erosion and sediment loading.

Under the Proposed Action, development of 1,491 natural gas wells would cumulatively result in 7,584 additional acres of surface disturbance, including 325 miles of new roads. The Gasco development would add cumulatively to the overall impact of human development on the water resources of the CIAA with impacts similar to those described above. Under Alternative B, development of 1,114 new wells and 274 miles of new road would result in 5,685 additional acres of surface disturbance. Under Alternative C, development of 1,887 new wells and 526 miles of new road would result in 9,982 additional acres of surface disturbance. Under the No Action Alternative, development of 368 new wells and 72 miles of new road would result in 2,055 additional acres of surface disturbance. Under Alternative E, development of 1,114 new wells and 106 miles of new road would result in 2,174 additional acres of surface disturbance. Under Alternative F, development of 1,298 new wells and 198 miles of new road would result in 3,604 additional acres of surface disturbance. The impacts of Alternatives B, C, D, E, and F on water resources cumulatively would be the same as described above for the Proposed Action. The differences between the alternatives would be the degree of impacts as it is related to surface disturbances, as described above.

For the Gasco project, 1,500 barrels per well of fresh water would be used for casing strings, rig washing, and other drilling- and construction-related activities and would come from sources tributary to the Green River. Over the life of the proposed project, an estimated 71 to 365 acre-feet (under the Proposed Action and alternatives) would be withdrawn from the Green River Basin, in addition to the projected overall depletion of 59,535 acre-feet of water flow in the Green River resulting from reasonably foreseeable oil and gas development in the CIAA. Assuming this water would eventually reach the Green River, Gasco's water use represents an annual depletion of approximately 0.0000001% to 0.000006% above the 0.033% annual depletion projected to occur from reasonably foreseeable oil and gas development.

Increased sedimentation and turbidity of surface waters would be expected from erosion resulting from project activities. The estimated 2,055 to 9,982 acres of surface disturbance resulting from construction activities (under the Proposed Action and alternatives) would produce between 133,179 and 682,905 tons of sediment above the the anticipated 8,618,287 tons expected in the CIAA due to oil and gas development, over 34 years. Assuming 20% of this range of sediment reached the Green River, which has an annual sediment load of 9,684,000 tons, this represents an addition of between .01% to 0.04% above the amount projected to be delivered to the Green River from reasonably foreseeable projects. Lower and Upper Pariette Draw and Nine Mile Creek are the only other perennial streams that would be impacted by increased sediment delivery.

It is difficult to quantify increases in salinity and selenium resulting from surface runoff from the project area. However, soils are classified based on restrictive features, including excess salt, which includes potential risks of both salinity and selenium impacts. Under the Proposed Action and alternatives, between 107 and 682 acres of disturbance would occur to soils where salt is a restrictive feature. This amount of disturbance is between 4.9% and 7.2% of the total area of surface disturbance under each of the alternatives, and represents an indication of potential for increased salt load to the waters of the project area.

There are approximately 31,650 acres of wetlands and riparian zones in the CIAA (BLM 2008b). Approximately 92,226 acres occur within the 100-year floodplains of the major drainages of the CIAA (BLM 2008b). Wetlands and riparian zones comprise only a small portion—1,249 acres or 0.6%—of the 206,826-acre project area. Under the Proposed Action 11 acres, or 0.88% of the total acreage of riparian and wetland zones would be impacted by surface disturbance. Under the No Action Alternative, 4 acres (0.32%) would be impacted. Under the other alternatives, zero acres of riparian and wetland areas would be affected by development and production. The Gasco project would disturb between zero and 0.003% of the wetlands and riparian zones in the CIAA.

Floodplains represent a small portion of the project area as well—6,772 acres, or 3.3% of the project area. Under the Proposed Action, 223 acres of floodplains would be impacted by surface disturbance, or 3.3% of the total floodplain acreage in the project area. Under No Action, 63 acres would be disturbed, or 0.9% of the floodplains in the project area. Under alternative B, C, and E, between 65 and 238 acres of floodplains would be disturbed, representing between 1% and 3.5% of all floodplains in the project area. The Gasco project would disturb between 0.07% and 0.26% of the 100-year floodplains of the CIAA. Under Alternative F, no floodplains would be affected. Thus, the Gasco project would add cumulatively only a small amount of disturbance to riparian and wetland zones and floodplains in the CIAA.

Impacts from other mineral use (oil shale, tar sands, locatable minerals and salable minerals) are difficult to quantify; however, any erosion resulting from related surface disturbance would also be expected to contribute to sedimentation and surface waters turbidity.

4.18.3.15 WILDLIFE

The CIAA for impacts to wildlife resources is the Vernal FO planning area. This CIAA accounts for impacts to wildlife resources that are collectively affected by ongoing resource management and energy extraction in this region, and are generally managed under a common land use plan. Direct impacts to big game species would include conversion of forage and cover (habitat) to roads, well pads, and related facilities and subsequent habitat fragmentation and displacement.

Fatalities from vehicle collisions have, and would continue to occur. Indirect impacts occur from the noise and presence of people, vehicles, and equipment. Disturbance drives animals from their preferred habitat. Increased poaching and harassment of animals also results from the access provided from the road network.

Surface disturbance fragments habitat for big game and migratory birds. Upland game and birds lose breeding habitat due to surface disturbance. They also experience increased hunting pressure due to the expanded road network. Reptiles, amphibians, and other non-game species similarly lose habitat due to construction of roads, well pads, and related facilities, and the expanded road network results in an increased potential for mortality from vehicle collisions.

Past and ongoing oil and gas exploration in the CIAA has disturbed 38,234 acres of land, including 2,988 miles of access road. Reasonably foreseeable future actions and development would include construction of an anticipated 23,814 oil and gas wells and 4,763 miles of associated roads would result in 63,213 acres of surface, and thus habitat, disturbance.

Continued travel along between 14,374 miles of existing roads in the CIAA, and improvement and construction of 400 miles of non-motorized trails, and improvement and construction of 800 miles of motorized trails for backcountry recreational driving would provide continued and expanded human access to public lands. The impacts to wildlife would include the habitat disturbance and species displacement and mortality described above. However, limiting motorized travel almost entirely to designated routes, would reduce those impacts, as compared to cross country travel.

Forest and woodland treatments (on up to 546,152 acres), vegetation treatments to enhance livestock forage (on between 34,640 and 50,900 acres), prescribed fire (on 312,850 acres), and vegetation restoration projects (on 200,000 acres) would result in surface and vegetation disturbance. In the short term, these actions would disturb habitat and displace wildlife. In the long term, however, these land and vegetation treatments would maintain and enhance vegetation condition and benefit wildlife by enhancing forage, cover, and other elements of wildlife habitat. It should be noted, however, that these different types of vegetation treatments would likely overlap, and the total acres of all lands treated cannot be added.

Other actions are anticipated that would also impact wildlife and their habitat. Construction of livestock and wildlife waters (e.g., wells, springs, guzzlers, pipelines, and reservoirs), limiting livestock grazing in riparian zones to maintain and achieve proper functioning condition, prohibiting and minimizing human disturbance around raptor nest and sage-grouse leks, and prohibiting disturbance to, and reclaiming disturbance in, critical deer and elk winter range would all improve and enhance habitat for wildlife.

Under the Proposed Action, development of 1,491 natural gas wells would cumulatively contribute 7,584 additional acres of surface disturbance, including 325 miles of new roads in wildlife habitat. The impacts to wildlife in the project area would be the same as other energy development throughout the CIAA described above. Thus, the Gasco development would add cumulatively to the overall impact of energy development to wildlife and their habitat in the CIAA. Under Alternative B, development of 1,114 new wells and 274 miles of new road would result in 5,685 additional acres of surface disturbance in wildlife habitat. Under Alternative C, development of 1,887 new wells and 526 miles of new road would result in 9,982 additional acres of surface disturbance. Under the No Action Alternative, development of 368 new wells and 72 miles of new road would result in 2,055 additional acres of surface disturbance. Under Alternative E, development of 1,114 new wells and 106 miles of new road would result in 2,174 additional acres of surface disturbance. Under Alternative F, development of 1,298 new wells and 198 miles of new road would result in 3,604 additional acres of surface disturbance. The cumulative impacts of Alternatives B, C, D, E, and F on wildlife and their habitat would be the same as described above for the Proposed Action. The differences between the alternatives would be the degree of impacts to wildlife and their habitat, as it is related to surface disturbances and human presence.

4.18.3.16 Wilderness Characteristics

During the planning process, a BLM interdisciplinary team inventoried 34 areas in the Vernal FO to determine if they possessed wilderness characteristics. The Vernal FO determined that 25 of the 34 areas outside of existing WSAs, totaling approximately 277,596 acres, were found to have wilderness characteristics. At the same time, they determined that 133,723 acres did not possess wilderness characteristics. The lands found to have wilderness characteristics were carried through the land-use planning process to assess the impacts of management options on these lands and to determine how their wilderness characteristics would be managed. The Vernal ROD carries forward 14 areas, totaling 106,198 acres, as BLM natural areas that are to be managed to protect, preserve, and maintain their wilderness characteristics values.

The CIAA for wilderness characteristics is Vernal FO planning area. Included in the cumulative impact analysis are all lands found by the Vernal FO to possess wilderness characteristics since 1996. These areas possess all of the values needed for wilderness, including size, naturalness, and opportunities for solitude or primitive and unconfined recreation.

Of the 277,596 acres found to have wilderness characteristics during the re-inventory, 106,198 acres are protected, preserved, and maintained for their wilderness values in the Vernal ROD as BLM natural areas. In accordance with management prescriptions in the ROD, these areas would remain in a pristine state. The remaining 171,398 acres do not have prescribed management to protect the wilderness values, and allow for uses that can degrade the wilderness characteristics of these areas. The Desolation Canyon wilderness characteristics area falls within this category of lands.

UDOGM 2011 data indicated there are currently approximately 50 wells within Desolation Canyon non-WSA lands with wilderness characteristics. Using the assumptions contained in Section 4.18.2.1.1, this past and current development has resulted in approximately 125 acres of long-term surface disturbance. Each project was individually analyzed in other EAs or EISs.

The action alternatives in this EIS would preclude BLM from preserving the wilderness values on 6 to 13,965 acres (up to 35%) of the Desolation Canyon non-WSA lands with wilderness characteristics due to surface disturbance associated with the oil and gas proposed activities. The Vernal ROD (2008) does not carry the Desolation Canyon area forward as a BLM natural area for the protection, preservation, or maintenance of the wilderness characteristics. The analysis in the Vernal RPM (2008c) clearly portrays that 66% of the Desolation Canyon area was leased, and under the RMP, it would have a direct loss of natural characteristics and reduction in quality of the opportunities for solitude and primitive and unconfined recreation due to sights and sounds of development. As disclosed in the RMP, it is expected that cumulatively, up to 72% of the Desolation Canyon non-WSA lands with wilderness characteristics would no longer retain wilderness characteristics due to the additive and cumulative effects of oil and gas development.

During the wilderness characteristics review between 1996 and 2007, 411,319 acres were re-inventoried by the BLM (see Chapter 3, Vernal RMP). As previously identified, 277,596 acres were found to have wilderness characteristics. A loss of 13,965 acres of wilderness characteristics lands in the Desolation Canyon non-WSA lands with wilderness characteristics area would result in the loss of 5% of all wilderness characteristics lands in the Vernal FO.

Additional reasonably foreseeable oil and gas development could affect (or are affecting) other non-WSA lands with wilderness characteristics within the Vernal FO area. BBC's West Tavaputs Plateau EIS, EOG's North Alger EA, XTO's River Bend Unit Infill EA, and the Programmatic EIS for Tribal Lands would impact Desolation Canyon non-WSA lands with wilderness characteristics. The Greater Natural Buttes Draft EIS (BLM 2010b) and the Southman EA would impact the White River non-WSA lands with wilderness characteristics. The Enduring Resources Big Pack EA project would impact the Lower Bitter Creek and Sunday School Canyon non-WSA lands with wilderness characteristics. The Programmatic EIS for Tribal Lands would also impact Wolf Point non-WSA lands with wilderness characteristics.