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Final Environmental Impact Statement

South Unit Oil and Gas Development Project

Duchesne/Roosevelt Ranger District, Ashley National Forest
Duchesne County, Utah

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South Unit Oil and Gas Development Project
Final Environmental Impact Statement
Duchesne County, Utah
(Volume 1 of 2)

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Abstract: Berry Petroleum Company has submitted a Master Development Plan (MDP) to explore and develop oil and gas reserves in the South Unit of the Ashley National Forest in Duchesne County, Utah. This MDP is defined as the Proposed Action within this Final Environmental Impact Statement (FEIS). The Project Area includes approximately 25,900 acres and is located 11 miles south of Duchesne, Utah, in Township 6 South, Ranges 4 and 5 West.

The purpose of this project is to respond to the formal MDP submitted by the Operator. The Operator's proposed development is intended to exercise their lease rights, and develop oil and gas resources within their existing federal oil and gas leases, located on the South Unit of the Ashley National Forest. As part of its decision-making responsibility and authority to evaluate the Operator's proposal, the Forest Service must also identify the terms and conditions necessary to protect surface resources and prevent conflicts with other activities, programs, and users in the area of operations.

The FEIS serves to disclose and compare the effects of implementing the alternatives. Four alternatives were evaluated including the No Action alternative which would maintain existing conditions. Under the No Action Alternative current management plans would continue to guide management of the Project Area. Under the No Action Alternative, the Operator's proposal would be rejected and no additional oil and natural gas exploration or development in the Project Area would be authorized beyond what has already been approved. Authorizations for and impacts from previously approved oil and natural gas exploration and surface disturbance would continue. The No Action Alternative serves as a baseline enabling decision makers and the public to compare the magnitude of environmental consequences across action alternatives. Current surface disturbance in the Project Area, as of September 2011, is estimated to be 168 acres, with 22 existing well pads and approximately 39 miles of roads.

The three action alternatives vary in terms of timing of development, number and size of well pads, number of wells per pad, miles of new road construction road needed to access the well

pads and acres of surface disturbance. The total number of well pads varies from 374 in alternatives 2 and 3 to 162 in alternative 4. The number of wells stays constant in all alternatives allowing up to 400 wells drilled, using a combination of new and existing well pads. however alternative 2 uses conventional drilling while alternative 3 requires a phased development approach to drilling, and alternative 4 (the preferred alternative), requires the use of directional drilling with multiple wells per well pad limiting the number of well pads and road miles needed.

Decision subject to Appeal: The Responsible official's decision is documented in the Record of Decision, and is subject to administrative review (appeal) pursuant to 36 CFR Part 215. Appeals must be filed within 45 days from the publication date of the legal notice of decision in the newspaper of record.

SUMMARY

The Forest Service has received a proposal for a Master Development Plan (MDP) from Berry Petroleum Company (Operator) for oil and gas resource development in the South Unit of the Ashley National Forest in Utah.

Proposed Action

In January 2007, the Operator submitted a MDP to the Forest Service to drill up to 400 oil and gas wells on up to 400 new well pads on federal mineral leases the Operator holds on approximately 25,900 acres in the South Unit of Ashley National Forest. The initial proposal was later refined during discussions between the Operator and the Forest Service. The refined project proposal is to construct up to 374 new well pads, and drill up to 400 wells using a combination of new and existing well pads. This refined proposal is considered the Proposed Action within this Final Environmental Impact Statement (FEIS).

As proposed, wells would be drilled from well pads constructed of native soil and rock material using standard cut and fill methods. Well pad construction would require an estimated 2.5 acres of surface disturbance per well pad. Approximately 77 miles of new access roads would be built and up to 20 miles of existing roads would be reconstructed to a higher standard. The proposal calls for a 20-year construction and drilling period.

Purpose and Need for Action

The purpose and need for Forest Service action is to respond to the formal MDP submitted by the Operator. The Operator‘s proposed development is intended to exercise their lease rights, and develop oil and gas resources within their existing federal oil and gas leases, located on the South Unit of the Ashley National Forest. As part of its decision-making responsibility and authority to evaluate the Operator‘s proposal, the Forest Service must also identify the terms and conditions necessary to protect surface resources and prevent conflicts with other activities, programs, and users in the area of operations.

Public Involvement

Publication of the Notice of Intent (NOI) to prepare an EIS was the first step of initiating the public scoping phase of the project. The NOI was published on Wednesday, August 29, 2007, in the Federal Register, Volume 72, No. 167, pages 49,696–49,697. The publication of the NOI initiated the formal 45-day public scoping period. The NOI complied with all of the requirements of 40 Code of Federal Regulations 1508.22 and Forest Service Handbooks 1909.15.21 and 1909.15.11. The Draft EIS was issued in February 2010 and the Notice of Availability was published in the Federal Register on March 5, 2010. The public had 60 days to comment on the Draft EIS. The Response to Comments (RTC) submitted on the Draft EIS is contained in Volume 2 of the FEIS. The Forest Service has prepared this FEIS which includes updates to the original analysis, as based on substantive comments received.

Issues

The public and internal scoping process identified 1) physical, biological, and socioeconomic resources that could be affected by the proposed project; and 2) issues related to each resource that would be analyzed in detail in the EIS. Identification of the specific resources and related issues was then used to identify potential alternatives to the

Proposed Action and to determine which alternatives would be carried forward for detailed analysis.

Issues related to six resources (air quality, cultural resources, recreation, socioeconomics, soils, and wildlife) were identified during scoping. The interdisciplinary team (IDT) has brought forward additional issues to be considered during the formulation of alternatives. For each issue, indicators were identified to measure direct, indirect, and/or cumulative impacts and to determine whether subsequent mitigation may be applied for an issue or resource.

Issues discussed in detail in this EIS include potential impacts to air quality, geology and paleontological resources, cultural resources, socioeconomics and environmental justice, water resources, soils, livestock grazing, transportation, vegetation (including special status species and noxious weeds), visual resources, recreation, roadless characteristics, potential wilderness areas, and wildlife (including special status and management indicator species).

Alternatives Considered in Detail

The Forest Service has developed four alternatives for analysis in response to issues raised by the public, identified by the IDT, and in cooperation with the State of Utah and Bureau of Land Management.

- The No Action Alternative (Alternative 1) is included in compliance with National Environmental Policy Act requirements, and is intended to provide a baseline against which to compare effects of the action alternatives (Alternatives 2, 3, and 4).
- Alternative 2 is the Operator‘s Proposed Action.
- Alternative 3 is a phased development alternative, which would allow drilling to extract oil and gas resources while adding additional protection measures for key resources in the Project Area. This alternative would require a phased approach to drilling wherein one option would be to drill leaseholds from east to west and north to south within the Project Area.
- Alternative 4 is the Preferred Alternative. It would require the use of directional drilling, with multiple wells per well pad, to minimize the number of well pads and access roads required. Surface disturbance would be limited to an average of four well pads per section, for a maximum of 162 well pads across the Project Area. All wells would be required to be drilled from those 162 well pads, with each well pad up to 3 acres in size to safely accommodate multiple wells.

Decision Framework

The authorized officer, or responsible official, for this action is the Forest Supervisor of the Ashley National Forest. To fulfill the Forest Service‘s responsibility and meet the purpose and need for action, the Forest Supervisor has considered and evaluated available information in order to decide whether to allow development to occur as proposed, or to allow implementation of a reasonable alternative to the Proposed Action. A Record of Decision (ROD) has been prepared and accompanies this FEIS. The ROD documents the decision maker‘s selected alternative and rationale for the decision. The selected alternative will establish the terms, conditions, and mitigations needed to protect surface resources during the proposed oil and gas development. Specific ground-disturbing developments (wells, roads, compressors, etc.) would require additional analysis prior to

implementation, to determine whether those developments are consistent with the scope and requirements of the selected alternative. Approval for such actions on individual well sites would be conducted through the Application for a Permit to Drill process, in cooperation with the Bureau of Land Management.

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Appendix C – Air Quality Technical Support Document
Appendix D - Cultural Resources Programmatic Agreement
Appendix E – Response to Comments on DEIS

ABBREVIATIONS AND ACRONYMS

µeq/l	microequivalents per liter
$\mu g/m^3$	micrograms per cubic meter
AADT	Annual Average Daily Traffic
ACGIH	American Conference of Governmental Industrial Hygienists
amsl	above mean sea level
ANC	acid neutralizing capacity
ANF	Ashley National Forest
AO	Authorized Officer
APD	Application for Permit to Drill
AQ	air quality
AQRV	air quality related value
AQTSD	Air Quality Technical Support Document
AU	Assessment Unit
AUM	Animal Unit Month
BCC	Birds of Conservation Concern
b_{ext}	light-extinction coefficient
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BMP	Best Management Practice
BTEX	benzene, toluene, ethylbenzene, xylene
CAA	Clean Air Act
CAAQS	Colorado Ambient Air Quality Standards
CASTNet	Clean Air Status and Trends Network
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CIAA	Cumulative Impact Analysis Area
CMAQ	Community Multiscale Air Quality
CO	carbon monoxide
COA	Condition of Approval
CWA	Clean Water Act
DAQ	UDEQ Division of Air Quality
DAT	Deposition Analysis Thresholds
DCCC	Duchesne County Chamber of Commerce

DCFD	Duchesne County Fire Department
DCSO	Duchesne County Sheriff's Office
DDCT	Density and Disturbance Calculation Tool
DEIS	Draft Environmental Impact Statement
DFC	desired future condition
DWR	Division of Wildlife Resources
DWSPZ	Dinking Water Source Protection Zone
EA	Environmental Assessment
EIA	Energy Information Administration
EIS	Environmental Impact Statement
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
F	Fahrenheit
FEIS	Final Environmental Impact Statement
FLPMA	Federal Land Policy and Management Act
FSR	Forest Service Road
GHG	greenhouse gas
GIS	geographic information system
GPS	Global Positioning System
HAP	hazardous air pollutant
HP	horsepower
IDT	interdisciplinary team
IMPROVE	Interagency Monitoring of Protected Visual Environments
IPCC	Intergovernmental Panel on Climate Change
IRA	inventoried roadless area
ISC	Industrial Source Complex
kg/ha/yr	kilograms per hectare per year
km	kilometer
LGR	Lower Member of the Green River Formation
LOC	level of concern
LOP	life of the project
LRMP	Land and Resource Management Plan
LT	Land Type

Ma	million years ago
MA	management area
MACT	maximum achievable control technology
MBO	million barrels of oil
MBTA	Migratory Bird Treaty Act
MDP	Master Development Plan
MEI	maximum exposed individual
MgCl	magnesium chloride
mg/L	milligrams per liter
MGR	Middle Member of the Green River Formation
MIS	Management Indicator Species
MLE	most likely exposure
NAAQS	National Ambient Air Quality Standards
NADP	National Atmospheric Deposition Program
NALMA	North American Land Mammal Age
NEPA	National Environmental Policy Act of 1969
NESHAP	national emission standards for hazardous air pollutants
NFMA	National Forest Management Act of 1976
NHPA	National Historic Preservation Act of 1966
NOI	Notice of Intent
NO_2	nitrogen dioxide
NO_x	nitrogen oxide
NRA	Natural Resource Area
NRHP	National Register of Historic Places
NSPS	New Source Performance Standard
NSO	No Surface Occupancy
O_3	ozone
ORV	off-road vehicle
PFYC	Probable Fossil Yield Classification
PIF	Partners in Flight
PILT	Payments in Lieu of Taxes
PM	particulate matter
POD	Plan of Development
ppb	parts per billion

ppm	parts per million
PSD	Prevention of Significant Deterioration
RFA	reasonably foreseeable action
RfC	reference concentration
RFD	reasonably foreseeable development
RFD	Roosevelt Fire Department
RFDS	Reasonable Foreseeable Development Scenario
ROD	Record of Decision
ROS	Recreation Opportunity Spectrum
ROW	right-of-way
RPD	Roosevelt Police Department
SHPO	State Historic Preservation Officer
SLT	Standard Lease Term
SOW	Sowers Canyon Goshawk Territory
SO_2	sulfur dioxide
SO_x	sulfur oxide
SPCCP	Spill Prevention, Control, and Countermeasure Plan
SSA	Sole Source Aquifier
SWCA	SWCA Environmental Consultants
TCFG	trillion cubic feet of gas
TCP	Traditional Cultural Property
TDS	total dissolved solids
TLV	threshold limit value
TMDL	Total Maximum Daily Load
tpy	tons per year
TSL	toxic screening level
UAAQS	Utah Ambient Air Quality Standards
UAC	Utah Administrative Code
UBAQS	Uintah Basin Air Quality Survey
UCR	Uniform Crime Reporting
UCRB	Upper Colorado River Basin
UDEQ	Utah Department of Environmental Quality
UDOGM	Utah Division of Oil, Gas, and Mining
UDWQ	Utah Division of Water Quality

UEO	Utah Energy Office
UNHP	Utah Natural Heritage Program
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VMS	Visual Management System
VOC	volatile organic compound
VQO	visual quality objective
VR	visual range
VRM	Visual Resource Management
WAAQS	Wyoming Ambient Air Quality Standards
WGFD	Wyoming Game and Fish Department
WRCC	Western Regional Climate Center

CHAPTER 1.0 PURPOSE AND NEED FOR ACTION

1.1 Document Structure

The U.S. Department of Agriculture (USDA) Forest Service (Forest Service) has prepared this Final Environmental Impact Statement (FEIS) in compliance with the National Environmental Policy Act of 1969 (NEPA) and other relevant federal and state laws and regulations. This FEIS discloses the direct, indirect, and cumulative environmental impacts that could potentially result from the Proposed Action and alternatives. The document is organized into the following major sections.

Chapter 1. Purpose and Need for Action: This chapter includes information on the history of the project proposal, the purpose of and need for the project and for Forest Service action, and the agency's decision-making framework. This chapter also details how the Forest Service informed the public of the proposal and how the public responded.

Chapter 2. Alternatives, Including the Proposed Action: This chapter provides a more detailed description of the agency's Proposed Action as well as alternative methods for achieving the stated purpose. Alternatives considered in the EIS process represent a range of reasonable alternatives to address resource impacts or conflicts consistent with the intent of NEPA. The alternatives development process considered significant issues raised by the public and other agencies. This discussion also includes mitigation measures. A summary comparison table of the environmental consequences associated with each alternative is provided in this chapter.

Chapter 3. Affected Environment and Environmental Consequences: This chapter describes baseline (existing) conditions for each resource area, and the projected environmental effects of implementing the Proposed Action and other alternatives. This analysis is organized by resource.

Chapter 4. Consultation and Coordination: This chapter provides a list of EIS preparers and agencies consulted during the development of the EIS.

Chapter 5. References

Appendices: The appendices provide more detailed information to support the analyses presented in the EIS. Also included in the appendices are further details regarding the Proposed Action, Specialist Reports for key resources, and other plans. The appendices are arranged as follows:

- Appendix A – Berry Petroleum Company Master Development Plan
- Appendix B – Reclamation Plan
- Appendix C – Air Quality Technical Support Document
- Appendix D – Cultural Resources Programmatic Agreement
- Appendix E – Response to Comments on DEIS

Additional documentation, including more detailed analyses of Project Area resources, is provided in the Administrative Record located at the Ashley National Forest (ANF) office in Vernal, Utah.

1.2 Background

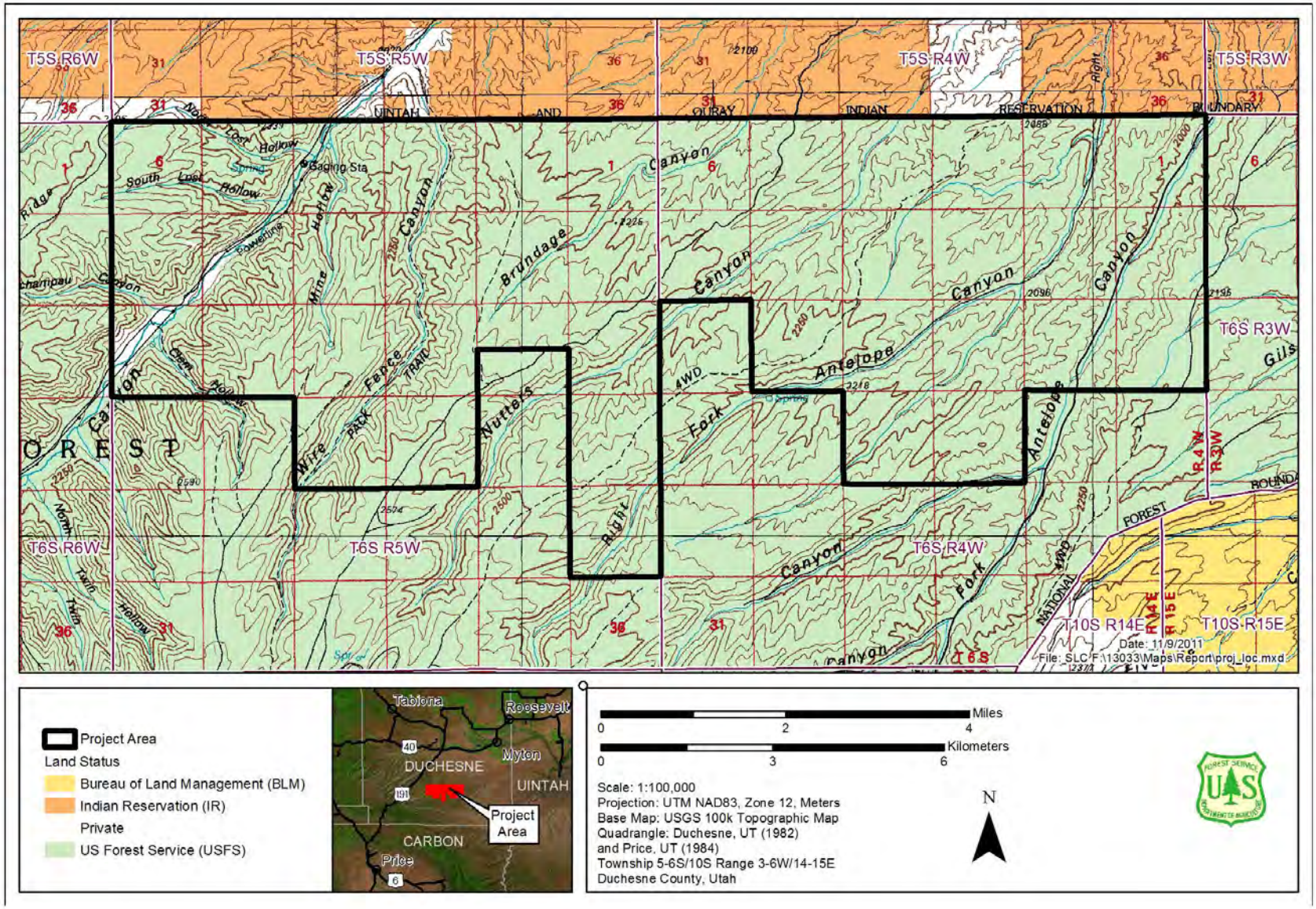
Berry Petroleum Company (Operator) submitted a Master Development Plan (MDP) (Appendix A) to explore and develop oil and gas reserves in the South Unit of the ANF in Duchesne County, Utah. A MDP can be prepared by an operator when the operator is planning oil and gas field development consisting of multiple wells. A MDP proposal can be addressed in a single NEPA analysis. This facilitates the consideration of cumulative effects early in the process and enables broad application of identified mitigation measures. Requirements and process elements for evaluation of an MDP by the Forest Service and Bureau of Land Management (BLM) are identified in the Onshore Oil and Gas Order Number 1 (43 Code of Federal Regulations [CFR] Part 3160 and 36 CFR Part 228).

The proposed project would be consistent with the forest planning decisions in the Western Uinta Basin Oil and Gas Leasing EIS and Record of Decision (ROD) (Forest Service 1997), which amended the ANF Land and Resource Management Plan (LRMP) (Forest Service 1986) to include the leasing of federal oil and gas resources and subsequent development of oil and gas wells on Forest Service-administered lands. The Project Area includes approximately 25,900 acres and is located 11 miles south of Duchesne, Utah, in Township 6 South, Ranges 4 and 5 West (Figure 1-1).

The Forest Service reviewed the MDP, and determined that it would likely have significant impacts in the area. In response to this proposal and in compliance with NEPA and the Council on Environmental Quality (CEQ) regulations implementing NEPA, the Forest Service prepared a Draft EIS (DEIS) to analyze the effects of the proposed MDP (or ―Proposed Action”) on the natural and human environment within, and in the vicinity of, the Project Area. Any authorizations and actions proposed for approval in the DEIS were evaluated to determine if they conform to the decisions in the 1986 ANF LRMP. As the agency responsible for lease issuance and administration, the BLM participated as a cooperating agency. The State of Utah also participated as a cooperating agency.

The DEIS provided the information necessary for the public and Forest Service decision-makers to understand the potential environmental impacts of the Proposed Action as well as the alternatives, and the effects of applied protective mitigation measures developed as part of the analysis in the DEIS. The Forest Service has prepared this FEIS which includes updates to the original analysis, as based on substantive comments received during the DEIS review process. The Response to Comments (RTC) submitted on the DEIS is contained in Appendix E of the FEIS. Finally, a ROD has been prepared and accompanies the FEIS. The ROD documents the Forest Service decision-makers‘ selected alternative and rationale for the decision.

Figure 1-1. Project Location Map.



1.3 Purpose and Need for Action

The purpose and need for Forest Service action is to respond to the formal MDP from the Operator to exercise their oil and gas lease rights, and to evaluate the environmental impacts of the proposal in accordance with LRMP management direction and in accordance with NEPA. These decisions should be consistent with the previous Forest Service decisions and lease obligations, including the Western Uinta Basin Leasing EIS, with rights granted by the oil and gas leases, and with direction from the ANF LRMP and Department and Agency policies. The purpose and need for BLM action is to, in conjunction with the Forest Service, respond to the formal MDP and evaluate the impacts in accordance with NEPA.

The Operator‘s purpose and need is to both explore for and extract, in an efficient and environmentally compatible manner, the recoverable oil and gas reserves in its existing federal oil and gas leases. The need for the project is to contribute to daily oil and gas delivery from the Uintah Basin to help meet the growing national demand for energy sources. Furthermore, the proposed project would exercise the Operator‘s existing right to drill for, extract, remove, and market oil and natural gas reserves under valid existing federal mineral leases on the South Unit of the ANF. National mineral leasing policies and the regulations by which they are enforced recognize the statutory right of leaseholders to develop federal mineral resources to meet continuing needs and economic demands so long as undue and unnecessary environmental degradation is not incurred.

The Federal Government‘s policy for minerals resource management as expressed in the Mining and Mineral Policy Act of 1970 is to ~~“~~foster and encourage private enterprise in the development of economically sound and stable industries, and in the orderly and economic development of domestic resources to help assure satisfaction of industrial, security, and environmental needs.” Within this context, the National Forests and Grasslands have an essential role in contributing to an adequate and stable supply of mineral and energy resources while continuing to sustain the land‘s productivity for other uses and its capability to support biodiversity goals.

Exploration and production of oil and natural gas located in the Project Area is in accordance with the President‘s National Energy Policy, Executive Order (EO) 13212. The policy calls for federal agencies ~~“to~~ develop a national energy policy designed to help the private sector and, as necessary and appropriate, state and local governments, promote dependable, affordable, and environmentally sound production and distribution of energy for the future.” By developing domestic reserves of natural gas, the United States would reduce dependence on foreign energy. The Energy Policy Act 2005 emphasizes the development of domestic energy reserves for supply and economic stability.

1.4 Summary of the Proposed Action

In the MDP, the Operator proposed to drill up to 400 oil and gas wells on up to 400 new well pads within its existing federal mineral leases. Approximately 100 miles of new access roads would be constructed, and up to 21 miles of existing roads would be upgraded to reach the proposed well pad sites.

The initial proposal was later refined during discussions between the Operator and the Forest Service. The refined project proposal is to construct up to 374 new well pads, and drill up to 400 wells using a combination of new and existing well pads. Approximately

77 miles of new access roads would be built and up to 20 miles of existing roads would be reconstructed to a higher standard.

This proposal has been developed by the Operator as a MDP, which is provided for in Onshore Oil and Gas Order No. 1 as a method of proposing multiple wells within a specific geographic area. The Operator anticipates drilling into targets within the Green River Formation. The proposed locations and spacing of wells would be consistent with the State of Utah spacing rules. In general, in the northern portion of the Project Area, wells would be drilled on approximately 40-acre spacing. In the southern portion of the Project Area, the potential for occurrence of economic quantities of oil and gas is generally believed to be lower and more exploratory 160-acre spacing of wells is envisioned.

The total number and specific locations of wells ultimately drilled within the Project Area, and their bottom hole density, would depend on factors such as production success, actual distribution of recoverable oil and natural gas, engineering technology, economic factors, commodity prices, availability of commodity markets, and site-specific environmental factors, which are all factors yet to be determined or subject to change.

Wells would be drilled from well pads constructed of native soil and rock material using standard cut and fill methods. Well pad construction would require an estimated 2.5 acres of surface disturbance per well pad. Existing arterial roads would provide the main access to the Project Area. Within the project area approximately 77 miles of new access roads would be constructed, and 20 miles of existing roads would be upgraded to provide safe and reasonable access to the proposed well pad sites. Construction activities would be subject to resource-specific timing constraints described in subsequent chapters. The proposal calls for a 20-year construction and drilling period.

The Operator‘s proposal assumes that all wells would be drilled conventionally (i.e., with vertical well bores). The proposed wells would be drilled to an average depth of approximately 6,000 feet. The typical well would require about 7 days to drill, 14 days to complete, and an additional 7 days for production equipment installation and well start up (approximately 28 days from spud to production). All cuttings and drilling fluids would be contained in the reserve pit. All pits, cellars, rat holes, and other bore holes unnecessary for oil and gas production, excluding the reserve pit, would be backfilled after the drill rig is released to conform to the surrounding terrain.

The project would include approximately 107 miles of gas gathering pipelines. Low-pressure lines would be poly pipe installed on the surface. High-pressure lines would be made of steel and buried. Gas gathering pipelines would parallel access roads in the vast majority of cases and add virtually no additional surface disturbance as they would utilize the 35-foot road right-of-way (ROW). The Operator anticipates the project would require about 10,000 horsepower (HP) of compression at four compressor stations (2,500 HP each) that would be located within or near the Project Area. The Proposed Action is further described in Chapter 2 and in Appendix A.

1.5 Decision Framework

The Ashley National Forest Supervisor is the responsible official for project decisions that apply to federal surface uses only. A separate decision will be prepared and signed by the BLM, which will apply only to the federal mineral estate. Decisions by other jurisdictions to issue (or not to issue) approvals to this proposal may be aided by the disclosure of impacts in this analysis.

Given the purpose and need, the deciding official will review the Preferred Alternative, the other alternatives, and the environmental consequences in order to make the following decisions:

1. The operator‘s right to drill for, extract, and market oil and natural gas reserves under its existing federal mineral leases
2. What design features or mitigation measures are necessary to minimize adverse environmental impacts associated with this project?
3. What if any restrictions will be used on the timing and scheduling (phasing) of well pad development and well drilling.

This FEIS is not a decision document. Its primary purpose is to disclose the environmental consequences which are anticipated to occur through implementation of the alternatives under consideration. The selected alternative is documented in the ROD. The selected alternative provides the framework for a new MDP, which will guide the future development of the South Unit. The selected alternative establishes the terms, conditions, and mitigation needed to protect surface resources during the proposed oil and gas development. The Forest Service will determine what levels of impacts are approved and what Conditions of Approval (COAs), Best Management Practices (BMPs), mitigation, monitoring, and surveying would be required. The BLM will assist in the review of site-specific Applications for Permits to Drill (APDs) and determine adequacy, and assist in the development of COAs, BMPs, mitigation measures, and monitoring requirements for individual site-specific wells and developments.

The ROD associated with this FEIS will not be the final review or the final approval for all actions associated with this proposal. The Forest Service must review and authorize each component of the project that involves the disturbance of federal lands on a site-specific basis. The method used to evaluate and authorize each surface-disturbing activity is typically an APD, ROW grant, or Sundry Notice, with supporting environmental record of review, which is required before any construction can occur. Evaluations at this level include more precise locations for wells, access roads, and other developments, unlike the conceptual, or programmatic, level analysis provided in this EIS. The BLM will assist in the downhole portion of the APD review, as required by law.

On May 28, 2009, the Secretary of Agriculture released a memorandum reserving decision-making authority to his office, for all projects on National Forest System lands involving road construction or timber harvest within inventoried roadless areas (IRAs). This reservation of authority ensures that actions in inventoried roadless areas are carefully evaluated while long term roadless policy is developed and relevant court cases move forward. Since this project involves road construction within an IRA, a final decision cannot be made on this project until it has been reviewed by the Secretary of Agriculture.

1.6 Regulatory Setting

The ANF has provided guidance, input, participation, and independent evaluation during EIS preparation. Other federal and state agencies participated in the preparation of this EIS as Cooperating Agencies. The State of Utah and the BLM acted as Cooperating Agencies.

This EIS was prepared in accordance with NEPA and CEQ regulations implementing NEPA (40 CFR 1500–1508), and it is in compliance with the LRMP and all applicable regulations and laws subsequently passed; CEQ's Considering Cumulative Effects under NEPA (CEQ 1997a); and the Energy Policy Act of 2005.

1.6.1 Federal Permits, Authorizations, and Coordination

Consistent with regulations regarding federal oil and gas leasing and operations (43 CFR Parts 3100 and 3160, respectively), oil and gas leases are issued by the BLM. The BLM and the Forest Service are required to coordinate oil and gas leasing decisions on Forest Service-administered lands.

Once the lease is issued, the leaseholder/operator must apply for and receive site-specific authorization(s) prior to drilling within the leasehold area. To meet required environmental obligations, the leaseholder/operator must submit to the BLM an APD or its associated application for ROW so that the appropriate environmental review may be prepared by the Forest Service with BLM assistance. Environmental documents, such as an Environmental Assessment (EA), Categorical Exclusion, or the appropriate environmental record of review for APD or ROW authorizations, often include site-specific COAs that add further site-specific operation requirements. Drilling of federal minerals is subject to the BLM's Onshore Oil and Gas Orders (43 CFR Subpart 3164 – Special Provisions). BLM Onshore Order Nos. 1 and 2 require an applicant to comply with the following conditions:

- operations must result in the diligent development and efficient recovery of resources;
- all activities must comply with applicable federal, state, and local laws, and with regulations applicable to federal leases;
- all activities must include adequate safeguards to protect the environment;
- disturbed lands must be properly reclaimed; and
- all activities must protect public health and safety.

Onshore Order No. 1 specifically states, "Lessees and Operators shall be held fully accountable for their contractors' compliance with the requirements of the approved permit and/or plan" (48 Federal Register 56226, December 20, 1983).

Pipeline and road ROWs on Forest Service-administered lands would be issued under the authority of the Mineral Leasing Act of 1920, as amended, and the Federal Land Policy and Management Act (FLPMA), as amended. ROW grants authorizing construction of ancillary facilities, access roads, and pipelines would grant the Operator certain rights subject to the terms and conditions incorporated into the grant by the Forest Service.

Ten Presidential EOs also affect implementation of the proposed project. These EOs, which are binding on all government agencies, place restrictions on government approval of construction activities and apply to wetlands (EO 11990), floodplains management (EO 11988), migratory birds (EO 13186), environmental justice (EO 12898), Native American sacred sites (EO 13007), historic trails (EO 13195), cultural resources and historic preservation (EO 11593 and EO 13287, respectively), invasive species (EO 13112), and facilitation of hunting heritage and wildlife conservation (EO 13443).

The Forest Service and the BLM must also adhere to specific provisions regarding the draining of federal minerals from adjoining nonfederal lands. These provisions are codified in 43 CFR 3100.2, which states that, upon determination that lands owned by the United States are being drained of oil or gas by wells drilled on adjacent lands, the BLM

may execute agreements with the owners of adjacent lands whereby the United States and its lessees shall be compensated for such drainage. In addition, where lands in any lease are being drained of their oil and gas content by wells on another federal lease, issued at a lower rate or royalty, or on nonfederal lands, the lessee shall both drill and produce all wells necessary to protect the lease lands from drainage. In lieu of drilling necessary wells, the lessee may, with the consent of the BLM, pay compensatory royalty. These provisions are also incorporated in the lease terms contained in all federal oil and gas leases (Form 3100-11). A list of the major permits, approvals, and authorized actions necessary to construct, operate, maintain, and abandon project facilities is provided in the project record.

1.6.2 Consistency with the Ashley National Forest Land and Resource Management Plan

The Project Area is within Forest Service-administered public lands guided by the ANF LRMP (Forest Service 1986), and subsequent amendments. All alternatives are consistent with management standards defined in the LRMP. The LRMP provides for integrated guidance for all natural resource management activities as required by the National Forest Management Act of 1976 (NFMA). The LRMP divides the ANF into unique management areas (MAs) with specific management prescriptions related to minerals activities for each area. The Project Area contains four types of MAs (Figure 1-2). The MAs within the Project Area, their associated management prescriptions for minerals, and acreages are summarized in Table 1-1.

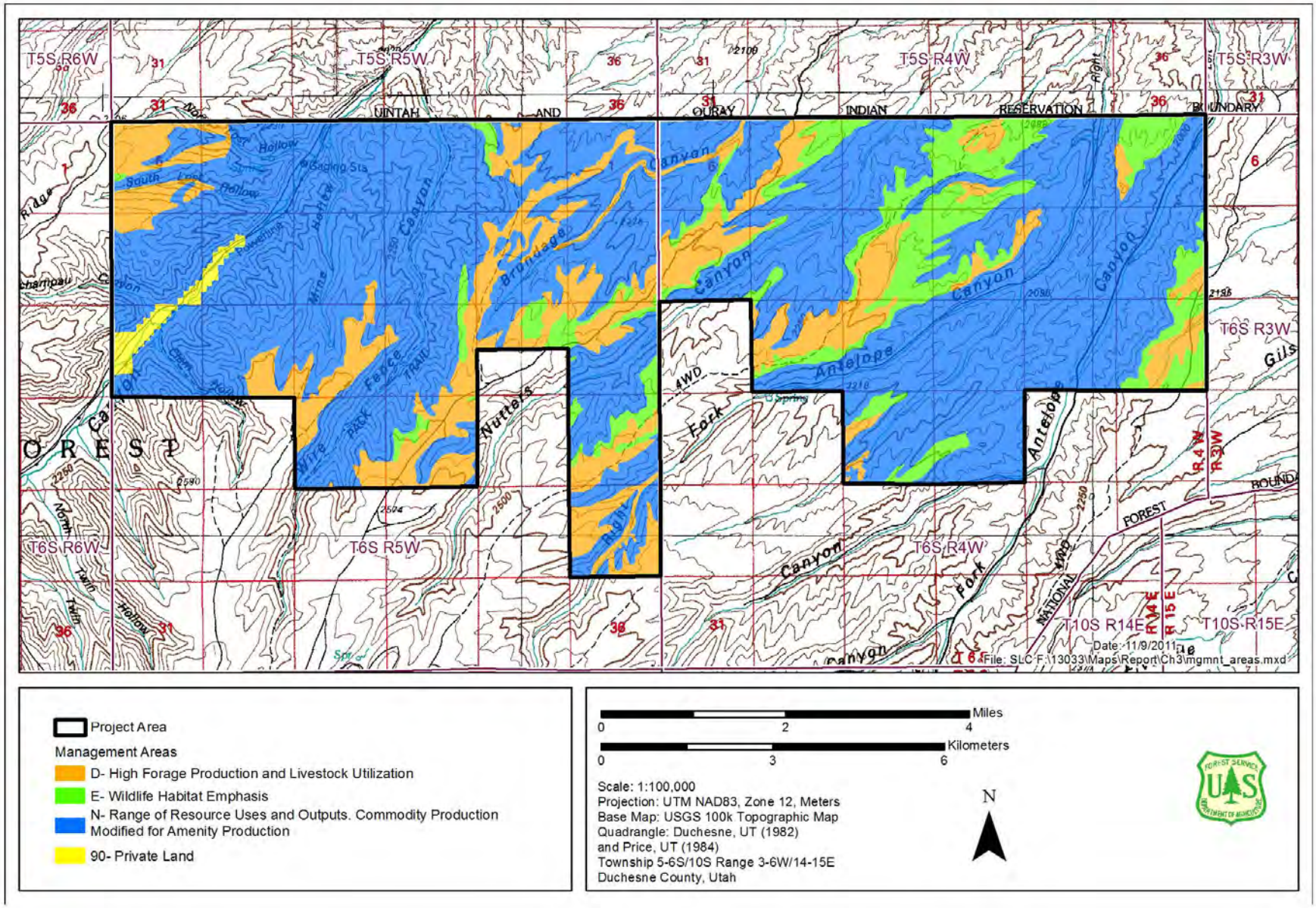


Figure 1-2. Management Areas in the Project Area.

Table 1-1. ANF LRMP Management Areas in the Project Area.

Management Area	Prescription for Minerals Activities	Acres in Project Area
D: High forage production and livestock utilization	Sites on primary and secondary range will be rehabilitated to improve forage production.	4,538
E: Wildlife habitat emphasis	May have seasonal restrictions for access or seismic work. No surface occupancy may be applied.	2,658
N: Range of resource uses and outputs. Commodity production modified for amenity production.	No restrictions other than what is in the Standards and Guidelines.	18,174
90: Private land	N/A	220

Potential management conflicts and associated mitigation for MAs D and E are discussed in the livestock grazing and wildlife sections, respectively. There would be no management conflicts for MA N, which is managed for a range of resource uses and outputs.

1.6.3 Consistency with the Western Uinta Basin Oil and Gas Leasing EIS

Anticipating future demands for oil and gas production from the South Unit of the ANF, the Forest Service prepared the Western Uinta Basin Leasing EIS (Forest Service 1996a, 1997). The Western Uinta Basin Oil and Gas EIS estimated how much oil and gas development might reasonably be expected to occur within the South Unit study area within 10 to 15 years; identified those areas that could be offered for leasing and development; and identified and analyzed the potential environmental impacts if such development were to occur. Specifically, the EIS estimated and analyzed the potential environmental effects of up to 35 wells in the ANF, including five exploratory wells and 30 development wells on the South Unit. The EIS also identified and established appropriate lease stipulations to minimize environmental impacts from such development. A ROD was released (Forest Service 1997), which authorized oil and gas leasing over large portions of the South Unit. Various areas of the South Unit were subsequently leased, including leases currently held by the Operator.

1.6.4 State and Local Permits, Authorization, and Coordination

The proposed project and alternatives are in conformance with state land use plans and with the current applicable land use, zoning, and/or comprehensive plans for Duchesne County. The proposed project is in conformance with all relevant state and county laws and regulations.

1.7 Public Involvement

To allow for an early and open process for determining issues to be analyzed in depth related to the proposed project (40 CFR 1510.7; Forest Service Manual 1950.41; Forest

Service Handbook 1909.15 Sec. 12.4), a public scoping period was held by the Forest Service. A Notice of Intent (NOI) to prepare an EIS was published in the Federal Register on August 29, 2007. Publication of this NOI initiated a 45-day scoping period that provided for acceptance of comments through October 12, 2007. During the scoping period, the Forest Service held public open houses on September 24, 25, and 26, 2007, in Salt Lake City, Duchesne, and Vernal, Utah, respectively. The Forest Service issued a news release to local media organizations notifying the public of the scoping period and open houses. A Scoping Notice was mailed to interested individuals, agencies, and organizations. All public notifications and documents for scoping were posted on the ANF projects webpage: http://www.fs.fed.us/r4/ashley/projects. Scoping comments were received from 10 individuals and organizations. The scoping comments and summaries of issues identified during scoping are provided in the Scoping Report (found in the project record).

The Notice of Availability for the DEIS was published in the Federal Register on March 5, 2010. During the 60-day public comment period, the Forest Service received comment letters from the following eight organizations: Duchesne County Commissioners, the State of Utah, Uintah County, Wasatch County, Central Utah Water Conservancy District, the U.S. Environmental Protection Agency (EPA), the U.S. Department of the Interior BLM, and a joint letter from the Utah Environmental Congress, WildEarth Guardians, Southern Utah Wilderness Alliance, Western Resource Advocates, and Western Watersheds Project. In total, 237 substantive comments were submitted. The Response to Public Comments Document is provided in Appendix E. A public meeting was held during the 60-day public comment period on March 18, 2010, at the ANF Duchesne Ranger District in Duchesne, Utah. No members of the public attended the meeting.

1.8 Issues

The scoping process identified 1) physical, biological, and social resources that could be affected by the proposed project and alternatives; and 2) issues related to each resource that would be analyzed in detail in the EIS. Identification of the specific resources and related issues was then used to identify potential alternatives and to determine which alternatives would be carried forward for detailed analysis (Chapter 2).

Issues to be analyzed in depth are issues that would be directly or indirectly caused by implementing the Proposed Action. Issues that were identified as 1) outside the scope of the Proposed Action; 2) already decided by law, regulation, Forest Plan, or other higher level decision; 3) irrelevant to the decision to be made; or 4) conjectural and not supported by scientific or factual evidence were not addressed in detail. The CEQ NEPA regulations explain this delineation in Sec. 1501.7, "…identify and eliminate from detailed study the issues which are not significant or which have been covered by prior environmental review (Sec. 1506.3)…" A list of these issues and reasons they were not addressed is provided in the Scoping Report in the project record.

Significant issues related to six resources (air quality, cultural resources, recreation, socioeconomics, soils, and wildlife) were identified during scoping. The interdisciplinary team (IDT) has brought forward additional issues to be considered during the formulation of alternatives. For each issue, indicators were identified to measure direct, indirect, and/or cumulative impacts and to determine whether subsequent mitigation may be applied for an issue or resource.

1.8.1 Air Quality

Several air quality issues were identified during scoping. Concerns included impacts of fugitive dust from roads in the Project Area and other access roads. Also of concern are the air quality impacts from emissions produced during development including fine particulates, nitrogen oxide (NO_x), sulfur oxide (SO_x), volatile organic compounds (VOCs), and ozone. The project may impact applicable National Ambient Air Quality Standards (NAAQS) and Prevention of Significant Deterioration (PSD) increments. Impacts to visibility and the potential for regional haze were concerns, particularly regarding how Class I and Class II airsheds would be affected by the project.

Respondents would like to see a comprehensive air quality model that includes past, present, reasonable foreseeable development, and other area emission sources. They suggested implementation of mitigation measures, including diesel engine technology, fugitive dust control measures, and use of flareless flowback and flash tank separators to reduce venting and flaring.

Indicators:

- Emissions related to truck transport and vehicle exhaust, including NOx, carbon monoxide (CO), and VOCs.
- Construction and operations emissions at the wells, including NOx, CO, and VOCs.
- Degradation of air quality related values and regional haze.
- Changes in visibility measured in deciviews.

1.8.2 Geology and Soils

Soil issues identified during scoping include how topsoil and vegetation removal would impact soil stability and erosion. Soil compaction could increase storm water runoff, sedimentation of streams, and invasive plant species.

The IDT concerns focused on areas that are susceptible to compaction or erosion including sensitive soils, biological crusts, and steep slopes. These areas tend to discourage the establishment of vegetation and successful reclamation may be an issue. For geology, the IDT considered the potential for development of hydrocarbon resources in the Uintah Basin, including economic potential.

Indicators:

- Acres of surface disturbance and soil exposure,
- Acres of surface disturbance on steep (>25%) slopes,
- Alteration of surface geologic formations reduced surface stability leading to increased landslide risk, soil contamination, and gully formation.
- Erosion potential and geologic stability, reduced soil fertility and productivity inhibiting re-establishment of vegetation.

1.8.3 Paleontology

Paleontological issues considered by the IDT included impacts to significant fossil resources in the Project Area.

Indicators:

- Acres of surface disturbance in areas with high potential for fossil resources.

1.8.4 Water Resources

Several surface water and groundwater issues were considered by the IDT. The project is located in the Antelope Creek and Upper Pariette Draw watersheds of the Green River Basin. Several intermittent drainages and one perennial stream flow through the canyons within the Project Area. Project-related concerns include potential impacts to channel stability, water quality, water quantity, aquatic life, and recreation. There were concerns that the project could increase levels of total dissolved solids (TDS), accelerate erosion, and increase salinity in the basin. There were initial concerns that groundwater use could impact availability for municipal and industrial and agricultural uses; however, groundwater withdrawal was not proposed within the project area.

Indicators:

- Degradation of surface water and groundwater quality, including TDS and salinity.
- Changes in designated uses due to degradation.
- Annual acre-feet of water used (depletions).
- Increased sedimentation into stream channels.

1.8.5 Vegetation and Noxious Weeds

Vegetation issues identified by the IDT include impacts related to the removal of vegetation communities. A majority of the Project Area is comprised of pinyon-juniper woodland. Removal of vegetation can increase noxious weed cover, increase sedimentation and erosion, and impact wildlife. Other issues include potential impacts to sensitive habitats, such as wetlands and floodplains, and to rare plants, particularly Untermann daisy (*Erigeron untermannii*) and Goodrich's blazingstar (*Mentzelia goodrichii*). To minimize these impacts, reclamation should include revegetation of disturbed areas and means to avoid the sources of weed invasions.

Indicators:

- Acres of each vegetation community removed.
- Increase in acres of noxious weeds.
- Change in plant species composition.

1.8.6 Wildlife

The IDT considered several wildlife issues during the formulation of alternatives, including impacts to big game, migratory birds, aquatic life, federally listed species, Forest Service sensitive species, and Management Indicator Species (MIS). Primary concerns include potential impacts to big game crucial ranges and migration corridors; _take' of migratory birds; impacts to greater sage-grouse leks; and water quality and depletion impacts that could affect downstream fishes and habitat.

Indicators:

- Acres of wildlife habitats disturbed.
- Level of fragmentation and edge effect from access roads and wells.

1.8.7 Grazing

Since the entire Project Area is used for grazing, potential impacts to allotments were considered. Issues include impacts to Animal Unit Months (AUMs) and rangeland

productivity. The project could reduce forage production, thereby reducing the number of cattle the allotments are able to support.

Indicators:

- Change in AUMs.
- Loss of acres of forage due to surface disturbance.
- Increased livestock mortality due to vehicle collisions.

1.8.8 Cultural Resources/Tribal Consultation

Potential impact to cultural resources in the Project Area was a concern raised during scoping. Lands on the Uintah and Ouray Reservations adjacent to the Project Area may be impacted by roads improvements and pipeline placements, when accessing the Project Area. Consultation between the Forest Service and the Uintah and Ouray Ute Nation should include discussions on access and cultural issues.

Indicators:

- Acres of surface disturbance in potentially sensitive areas.
- Increased traffic volume.

1.8.9 Recreation

Impacting recreational resources was a concern brought forward during scoping. Oil and gas development in the area could reduce recreational opportunities in the South Unit of the ANF and could lead to economic losses. Other recreation issues considered by the IDT included change in recreation opportunity; change in access for forest visitors due to increased roads; change of resource character for use as permitted; loss of habitat and change in hunting opportunity; fragmentation of habitat (roads); and loss of roadless and undeveloped character.

Indicators:

- Change in ROS to more developed settings.
- Reduced probability of success in hunting opportunities.

1.8.10 Potential Wilderness and Inventoried Roadless Areas

There could be effects to wilderness potential and inventoried roadless areas within the Project Area. Four areas with wilderness potential were identified in a 2005 inventory that was completed in preparation for revising the Forest Plan (the Forest Plan revision was not completed). These areas will be the base area identified as having wilderness potential and include the Cottonwood, Sowers Canyon East, Nutters Canyon, and Alkali Canyon potential wilderness areas.

Indicators:

- Acres with and without surface disturbance from the project in each area.
- Changes in conditions of wilderness attributes for the part of the area with surface disturbance.

Comments received on the DEIS have requested analysis of effects to inventoried roadless lands. Due to this public concern, an analysis of effects to roadless characteristics for roadless lands within the Project Area has been included.

Indicators:

- Acres with changes to conditions of roadless characteristics, and description of those changes.

1.8.11 Transportation

Transportation issues considered by the IDT include impacts from additional access roads and increased traffic. Concerns include safety, erosion, change in road management classification, and changes to the characteristics of roadless/undeveloped areas. Since access to the Project Area would include travel on tribal land, the Forest Service would consult with the Uintah and Ouray Nation about transportation issues.

Indicators:

- Miles and density of new access roads.
- Miles and density of existing roads that would be improved.
- Change in Annual Average Daily Traffic (AADT) and accident rates.

1.8.12 Visual Resources

IDT concern for maintaining visual quality to the level identified in the Forest Plan in assigned Visual Quality Objectives (VQOs) identified in the Project Area. Changes in the visual landscape may impact recreational opportunities.

Indicators:

- Meets or does not meet minimum Forest Plan VQOs for the area.

1.8.13 Socioeconomics and Environmental Justice

Socioeconomic issues raised during scoping focused on the economic stability of Duchesne County. Both potential positive and negative impacts to socioeconomics were identified. While some believe that oil and gas development would promote long-term economic stability in the area, others have concerns that the Proposed Action could reduce revenues from recreational activities.

Other socioeconomic issues the IDT considered included population and demographics; employment; quality of living (housing, law enforcement, health care, education); taxes and revenues; and environmental justice.

Indicators:

- Changes in employment rates, wages, housing availability, and community infrastructure.
- Changes in tourism, including recreation.

CHAPTER 2.0 ALTERNATIVES, INCLUDING THE PROPOSED ACTION

2.1 Introduction

This chapter describes and compares the alternatives considered within this EIS. It includes a description and map of each alternative considered. This chapter also presents the alternatives in comparative form to identify the differences between each alternative and provide a clear basis for evaluation and choice among alternatives by the decision maker and the public. Some of the information used to compare the alternatives is based upon the design of the alternative and some of the information is based upon the environmental and socioeconomic effects of implementing each alternative. For the purposes of this EIS analysis, certain assumptions have been made to develop a conceptual scope and pattern of development for each action alternative. This allows potential environmental impacts to be identified and evaluated.

2.2 Alternatives Considered in Detail

To represent a range of reasonable alternatives in conformance with the intent of NEPA, the Forest Service analyzed four alternatives for detailed evaluation in this EIS, including the Proposed Action and No Action Alternative.

2.2.1 Alternative 1 – No Action

Under the No Action Alternative, current management plans would continue to guide management of the Project Area. The Operator‘s proposal would be rejected and no additional oil and natural gas exploration or development in the Project Area would be authorized at this time. Authorizations for and impacts from previously approved oil and natural gas exploration and surface disturbance would continue. The No Action Alternative serves as a baseline enabling decision makers and the public to compare the magnitude of environmental consequences across action alternatives. As of January 2012, current surface disturbance within the Project Area resulting from oil and gas development is estimated to be 168 acres. This disturbance includes the construction of 22 well pads, construction of 5.4 miles of roads, and upgrading or reconstruction of 2.4 miles of existing roads to support oil and gas activities, and 74 wells either in production or approved for drilling but not yet drilled. There are approximately 39 miles of existing road within the project, including those constructed or reconstructed for oil and gas development activities. Locations of existing well pads and roads are illustrated on Figure 2-1.

The Operator‘s original MDP estimated that up to 400 wells would be needed in a full field development scenario. However, since receiving the Operator‘s proposed MDP 44 new wells have been approved via separate NEPA decisions. Most of those 44 approved wells have been drilled and the associated surface disturbances needed for those wells are included in the acres of surface disturbance listed above. For analysis purposes for the no action alternative, it is assumed that the remaining approved wells would be drilled. However, drilling of the remaining approved wells would not result in additional surface disturbance, as those wells would be accessed and drilled from existing roads and well pads.

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2.2.2 Alternative 2 – Proposed Action

The Operator‘s Proposed Action is a MDP to construct 374 new well pads and drill up to 400 wells using a combination of new and existing well pads (Figure 2-2). According to the Operator, the 400-well maximum represents a full development scenario based on currently known geologic and reservoir properties. Of these 400 wells, 44 have already been approved for drilling under separate, site-specific NEPA analysis. Most of these wells have already been drilled or are currently being drilled. This document analyzes the overall environmental effects of these previously approved wells in addition to the newly proposed wells. These wells are also part of the total number of proposed wells analyzed in all of the action alternatives and are subject to required mitigation and lease stipulations.

The total number and specific locations of wells ultimately drilled within the Project Area, and their bottomhole density, would depend on factors such as production success, actual distribution of recoverable oil and natural gas, engineering technology, economic factors, commodity prices, availability of commodity markets, and ROD stipulations and restrictions, which are all factors yet to be determined or subject to change.

Under the Proposed Action, it is assumed that all wells would be drilled conventionally (i.e., with vertical well bores and one well per well pad). Furthermore, all wells are anticipated to be drilled during an approximate 20-year period. The proposed oil and gas wells would be drilled to an average depth of 6,000 feet. The typical oil and gas well would require about 7 days to drill, 14 days to complete, with an additional 7 days for production equipment installation and well start up (about 28 days from spud to production). Between 10 and 50 wells may be drilled each year (Freeman 2008). All cuttings and drilling fluids would be contained in the reserve pit. All pits, cellars, rat holes, and other bore holes unnecessary for oil and gas production, excluding the reserve pit, would be backfilled after the drill rig is released to conform to the surrounding terrain.

All of the proposed wells would be drilled on existing federal mineral leases held by the Operator. The proposed locations and spacing of wells would be consistent with State of Utah spacing rules. In general, in the northern portion of the Project Area, where economic quantities of oil and gas are more likely to be present, wells would be drilled on approximately 40-acre surface spacing. In the southern portion of the Project Area the potential for occurrence of economic quantities of oil and gas is generally believed to be lower, and a more exploratory spacing of approximately 160 acres is envisioned. The actual spacing and geographic distribution of wells over the life of the project (LOP) would be based on actual discoveries of economic quantities of oil and gas resources. Well pads would not be placed in stream corridors, including intermittent and ephemeral washes. Well pads would not be located on slopes greater than 35%, per standard stipulations listed in the LRMP (Forest Service 1986).

Per well disturbance estimates at 40-acre well density are based on a 2.5-acre well pad. At the beginning of pad construction, surface soils would be salvaged and stockpiled adjacent to the well pad site for future use in site reclamation. A Reclamation Plan is included as part of this alternative. The Reclamation Plan, including quantitative monitoring requirements and standards for reclamation success, is presented in Appendix B.

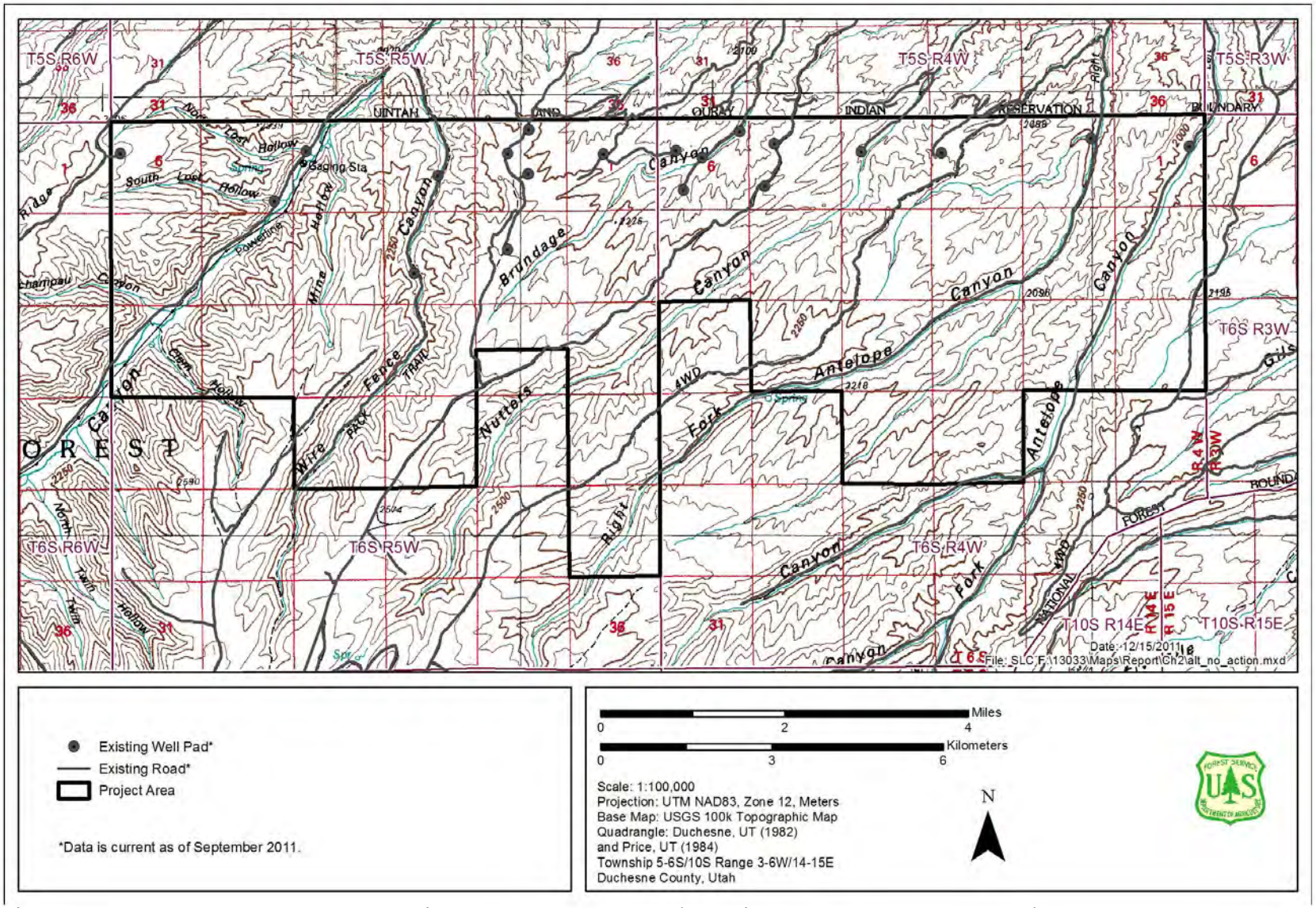
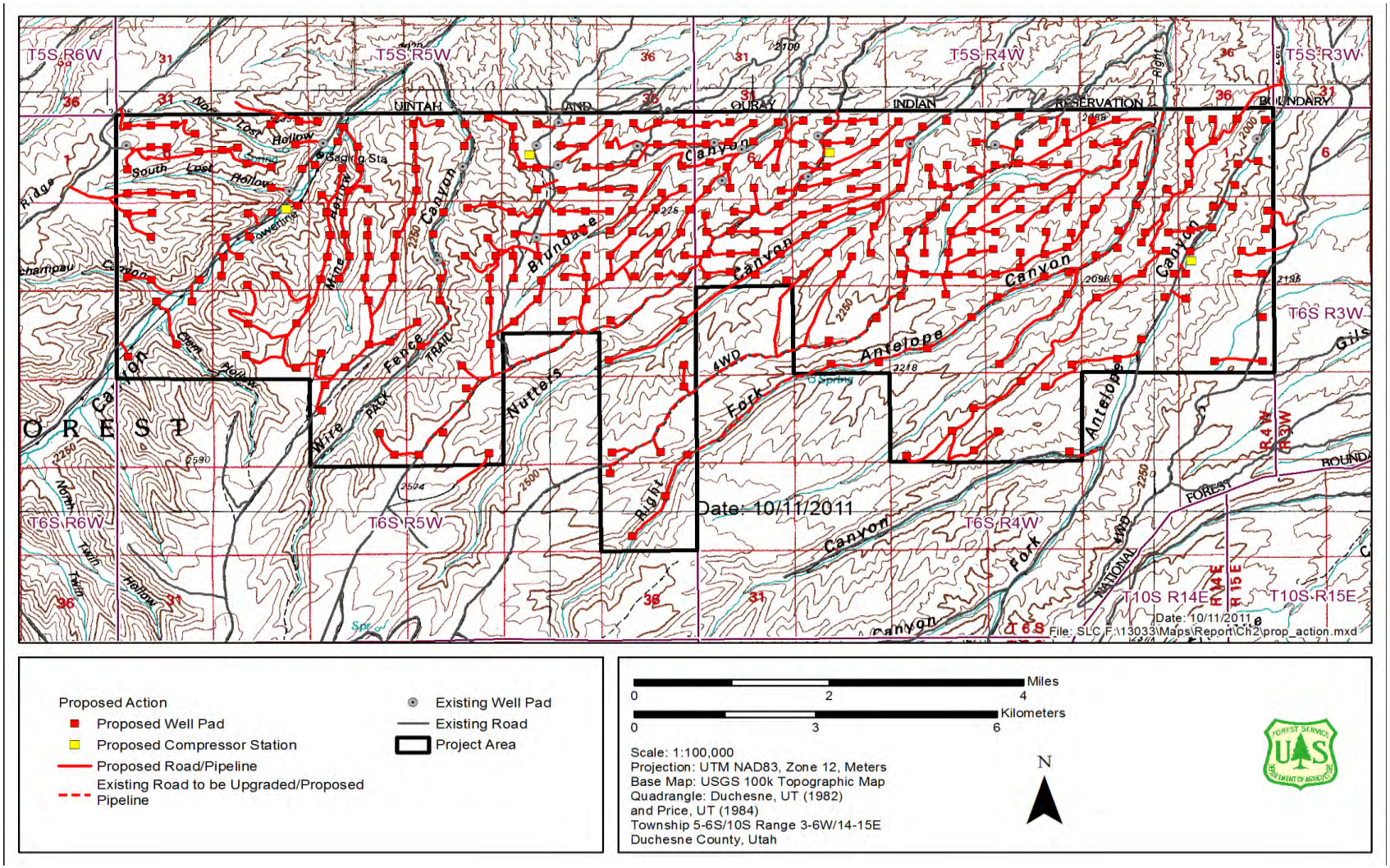


Figure 2-1. No Action Alternative Development Map.



Disclaimer: This map depicts a conceptual development scenario only. Actual development is proposed to occur in a similar manner as depicted; however, the specific locations would be determined by drilling results and coordination with the Forest Service and other appropriate agencies.

Figure 2-2. Proposed Action Conceptual Development Map.

Approximately 77 miles of new access roads would be constructed, and 20 miles of existing roads would be upgraded, to provide safe and reasonable access to the proposed well pad sites. These roads would utilize a 35-foot-wide construction ROW during construction. After construction is complete and gas gathering lines are installed, approximately 13 feet would be reclaimed leaving a 22-foot-wide road surface. Approximately 8 miles of new roads and upgraded roads would extend beyond the Project boundary, outside of the Operator‘s lease area, as shown on Figure 2-2. These 33 acres of disturbance are included in the short-term surface disturbance total. Roads constructed for this project would not be open for public travel and would be would be reclaimed at the end of the project. Roads will be recontoured to resemble the adjacent topography. Also, roads that were upgraded would be allowed to degrade back to pre-project conditions.

The project would include approximately 107 miles of gas gathering pipelines. Low-pressure lines would be poly pipe installed on the surface. High-pressure lines would be made of steel and buried. Gas gathering pipelines would parallel access roads in the vast majority of cases and add virtually no additional surface disturbance as they would utilize the 35-foot-wide construction ROW.

The Operator anticipates the project would require about 10,000 HP of compression at four compressor stations (2,500 HP each) that would be located within or near the Project Area. Potential locations for the compressor stations are shown on Figure 2-2, but these are conceptual locations, and actual locations of compressor stations would be determined through site-specific analyses and actual exploration and production needs.

New, short-term surface disturbance would total approximately 1,361 acres. Over the 5- to 20-year drilling phase, approximately 5.3% of the 25,900-acre Project Area would be affected by short-term disturbance (refer to Table 2-1 Comparison of Alternatives).

Interim reclamation would occur after a well is drilled and completed. The Operator would reduce the size of the well pad to the minimum surface area needed for production facilities including adequate room for oil trucks to turn around, while providing for reshaping and stabilization of cut and fill slopes. Operating well pads would be approximately 1.0 acre in size after 1.5 acres are reclaimed. Long-term disturbance associated with project development is estimated to be approximately 595 acres after interim reclamation (including 1-acre well pads, compressor stations, and roads). Within the entire Project Area, approximately 2.3% of the surface would be disturbed as a result of project development for the LOP. When existing disturbance, approximately 168 acres, is taken into account, the total long-term surface disturbance under the Proposed Action would be 2.9% of the area (Table 2-1).

Final reclamation would occur after a well is no longer productive. Each well would be plugged, capped, and all surface equipment would be removed at the end of its productive life. All surface pipelines no longer in use would also be removed. Buried pipelines would be plugged at specified intervals and abandoned in place. Each well pad would then be recontoured to resemble the adjacent natural topography and previously salvaged soil material would be spread over the surface of the pad site. The reclaimed surface would be reseeded with a seed mix determined by the Forest Service. Final reclamation would be performed and monitored in consultation with the Forest Service, including the control of noxious weeds, and in accordance with the 13-Point Surface Use Plan (Appendix A of the MDP [Appendix A of the FEIS]).

The Operator would adhere to all lease and APD conditions in addition to all federal and state laws, regulations, and policies implemented through statute and/or resource management planning decisions implemented through NEPA.

Various design elements and mitigation measures were identified in the Decision Notice and Finding of No Significant Impact for the 2006 EA for Berry Petroleum‘s Exploration and Development Project in the ANF (Forest Service 2006a). These design elements and mitigation measures have been included within the Proposed Action in order to avoid or minimize potential adverse environmental effects. These measures are above and beyond those required by the Operator‘s lease stipulations. The proposed design elements and mitigation measures are summarized below.

- A qualified paleontologist would monitor construction activities for proposed well pads and their access roads if potentially fossil bearing shallow or exposed bedrock is present. If significant paleontological resources are discovered, construction activities would be halted and the Forest Service notified. Operations in the area of the discovery would not resume until authorization to proceed has been received from the Forest Service.
- To prevent erosion of disturbed soils, vegetation and/or structural measures to control erosion would be implemented as soon as possible after initial soil disturbance.
- Energy dissipaters such as straw bales and silt fences may be required to prevent sediment delivery from disturbed areas to stream channels or floodplains. These structures would be installed during construction, and would be left in place and maintained for the LOP or until the disturbed slopes have revegetated and stabilized.
- At sites without clay soils, where soils are moderate to highly permeable, as well as sites closer to ephemeral/perennial channels, the reserve pit (if used) would be lined with a 20-mil pit liner on top of a protective felt layer to minimize the potential for pit fluid leaks.
- During the construction phase of the project, the Operator would implement an intensive reclamation and weed control program after each segment of project completion. The Operator would reseed all portions of well pads and road and pipeline ROWs not utilized for the operational phase of the project. Reseeding would be accomplished using Forest Service approved seed mix which would generally mimic native vegetation surrounding the specific well site. Post-construction seeding applications would continue until determined successful by the Forest Service. Weed control would be conducted through an approved Pesticide Use and Weed Control Plan from the Authorized Officer (AO). Weed monitoring and reclamation measures would be continued on an annual basis (or as frequently as the AO determines) throughout the LOP.
- Well pad and road construction, road upgrades, and drilling operations would not be conducted between November 15 and April 30, to protect elk winter range.
- Existing guzzlers present near proposed well pads would be moved by the Operator to reduce the impacts of increased traffic and human presence on elk, mule deer, and other wildlife utilizing those structures for drinking.
- Reduce fugitive dust from roads by employing speed limits and Appling water as needed. Water obtained for this purpose would be fresh water, not production water. If water application does not adequately reduce fugitive dust, the use of magnesium chloride (MgCl) would be considered; however, MgCl should not be applied within 100 feet of perennial streams, wetlands, springs, wet areas, or ambient water. In proximity to such settings gravel surfacing or non-chloride dust suppressants would be considered.

- The Operator would participate in multi-party, basin-wide air quality monitoring studies to monitor possible air quality impacts from the proposed activities, and help determine the effectiveness or need for air quality mitigation measures.
- Pump jack engines would be equipped with high-grade mufflers to reduce noise during the operational LOP.
- Ground-disturbing activities (road construction and upgrading, well pad construction, pipeline placement, etc.) will not be authorized until cultural resource identification and avoidance procedures have been completed as specified in the Berry Petroleum South Unit Programmatic Agreement (Agreement # AS-11-00017).The Cultural Resource Monitoring Plan as specified in the Berry Petroleum South Unit Programmatic Agreement (Agreement # AS-11-00017) will be implemented to evaluate indirect and cumulative effects of the project on cultural resources.
- If cultural resources are inadvertently discovered, construction activities will be halted within 100 feet of the discovery and the Forest Service notified. Operations in the area of the discovery will not resume until stipulations of the Forest inadvertent discovery plan have been fulfilled and the authorization to proceed has been received from the Forest Service.
- In addition to stormwater, operations would involve the storage and disposal of produced water and fracturing fluids. When properly managed these fluids do not pose a risk of contamination of surface water or groundwater, except in the event of an uncontrolled spill. The Proposed Action would include the implementation of a project Spill Prevention, Control, and Countermeasure Plan (SPCCP) that would minimize the risk of such spills by detailing techniques to prevent spills, and outlining measures to be taken in the event of a spill.

A detailed MDP is provided in Appendix A. This MDP was developed and provided by the Operator, and supplements the description of the Proposed Action provided above.

2.2.3 Alternative 3 – Phased Drilling

The purpose of this alternative is to allow drilling to extract oil and gas resources while adding additional protection measures for wildlife and sensitive soil resources in the Project Area. This alternative would require a phased approach to drilling wherein one option for the Operator would be to drill leaseholds from east to west and north to south within the Project Area. For example, all wells in an eastern swath would be drilled first before the rigs could move farther west. A conceptual map of the phased drilling is presented as Figure 2-3.

Each phase could be up to 10 square miles in size. The Operator would need to determine a drilling swath and present a Plan of Development (POD) to the Forest Service and cooperating agencies for review prior to development. A complete POD would include many of the components listed below. Once the Forest Service approves a POD boundary and components, development could proceed in that area. The purpose of a phased drilling approach would be to protect migrating mule deer by concentrating construction activities into smaller areas while minimizing noise, traffic, and other construction-related activities in large portions of the Project Area at any given time.

As with Alternative 2 approximately 77 miles of new access roads would be constructed, and 20 miles of existing roads would be upgraded, to provide safe and reasonable access to the proposed well pad sites. All newly constructed roads would be closed to public motorized access. Approximately 107 miles of gas gathering pipelines would be

necessary. Under Alternative 3, a separate POD would be required for drilling in crucial mule deer winter range and summer range as these areas do not have seasonal closures, per the lease stipulations. Again, a complete POD could include many of the components listed below.

Also under Alternative 3, no well pads would be allowed to be placed on slopes greater than 25%, which is stricter than the ANF's standard stipulation that restricts activity on slopes greater than 35%. Wells could be directionally drilled from less steep locations to extract resources within these areas. The purpose of this requirement would be to minimize the potential for erosion, gullying, and sedimentation into streams.

New, short-term surface disturbance would be approximately 1,355 acres. Over the 5- to 20-year drilling phase, approximately 5.2% of the Project Area would be affected by short-term disturbance at one time or another. Approximately 8 miles of new roads and upgraded roads would extend beyond the Project boundary, outside of the Operator's lease area, as shown on Figure 2-3. These 33 acres of disturbance are included in the short-term surface disturbance total.

Long-term disturbance associated with project development is estimated to be approximately 590 acres after interim reclamation (including 1-acre well pads, compressor stations, and roads). Within the entire Project Area, approximately 2.3% of the surface would be disturbed as a result of project development for the LOP. When existing disturbance, approximately 168 acres, is taken into account, the total long-term surface disturbance under the Alternative 3 would be 2.9% of the area. Final reclamation would occur after a well is no longer productive, as described for the Proposed Action.

2.2.3.1 Plan of Development Components

Development and approval of PODs would be required. PODs may be developed in stages, as the Operator's development plans become more concrete. The Forest Service may allow a POD for separate areas, on a site-specific basis. A draft POD would be required to be submitted for review and comment; a final POD, based on comments and discussion, would be submitted within a reasonable timeframe thereafter. APDs within the POD area could then be approved.

A complete POD would consist of the following components, if applicable.

- Cover letter containing Operator name, project name, and list of wells (name and number by lease, with legal description including quarter-quarter section).
- A strategy for limiting and/or mitigating sagebrush habitat fragmentation with the goal of maintaining large, unfragmented blocks of wildlife habitat and migration corridors. The plan would demonstrate significant control of fragmentation in a number of ways, including:
  - reducing surface density of facilities, roads, pipelines, and other ROWs;
  - focusing development near existing ROWs;
  - clustering facilities, including the use of directional drilling where feasible;
  - minimizing oil- and gas-related activity in sagebrush habitats, including reducing traffic through field road management, closing routes to public use, remote telemetry of wells, piping of produced fluids (where feasible) rather than trucking, etc.;
  - using new technologies, including surface mats, self-contained rigs, limited impact drilling (e.g., small roads and small pads);

  - requiring mandatory acceptance of BMPs; and
  - mitigation proposals.
- Master drilling plan.
- Master surface use plan, including plans for surface reclamation, a baseline calculation of total surface area currently disturbed by oil and gas activity in the Project Area by lease or unit, the total area to be disturbed through the proposed development, and monitoring approach to ensure compliance with the terms agreed upon in the POD.
- Water management plan.
- Cultural resource inventory plan.
- Wildlife monitoring plan.
- Project maps, including the following, as applicable:
  - surface ownership within the project boundary;
  - mineral ownership within the project boundary;
  - existing and proposed well sites;
  - compressor sites;
  - flow line routes;
  - utility line routes; and
  - transportation routes.
- APDs for each federal well.
- List of all permitting agencies involved.
- Surface owner agreements.
- Water mitigation agreements.
- Any additional information.

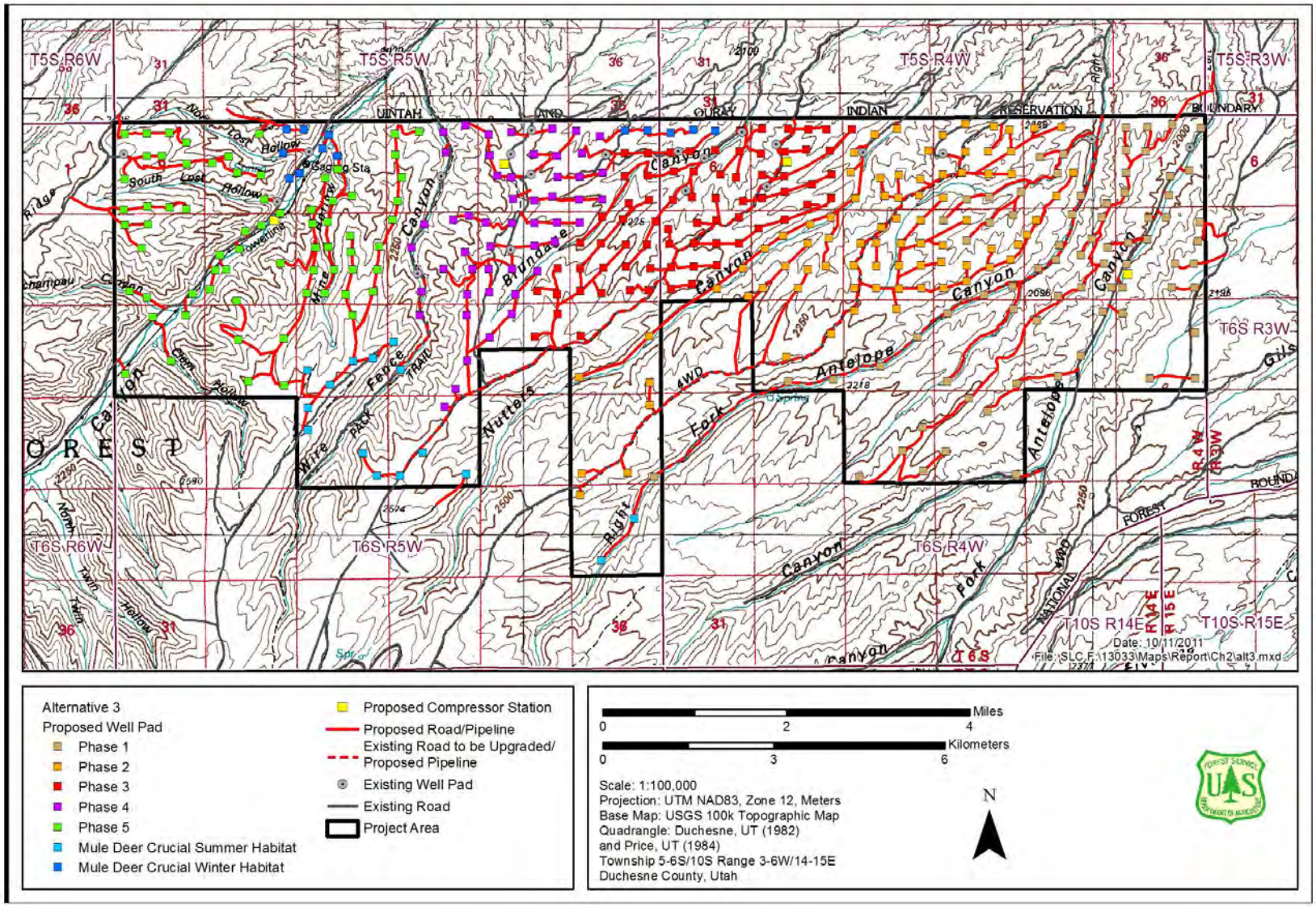
2.2.3.2 Application of BMPs

In addition to the design elements included in the Proposed Action, the following BMPs would be required to be evaluated for implementation at each development location. These could be evaluated on a POD or individual location basis. A checklist would be developed that may guide the application of appropriate BMPs for well development. Rationale for not including these BMPs in a POD would have to be provided by the Operator and evaluated by the Forest Service prior to approval.

2.2.3.3 Painting Production Facilities to Minimize Contrast with the Background

Goal: To minimize visual contrast by making production facilities less noticeable.

Description: Paint above-ground production facilities (pumping units, pipes, compressors, tanks, treaters, etc.) a color(s) that allows the facility to blend into the background. All new equipment brought onto the site should be painted the same color(s). The following considerations would be used when selecting a color and shade: 1) semi-gloss paints will stain and fade less than flat paints; 2) the background is typically a vegetated background and seldom a solid soil background; 3) the selected color should be one or two shades darker than the background; 4) consider the predominant season of public use.



Disclaimer: This map depicts a conceptual development scenario only. Actual development is proposed to occur in a similar manner as depicted; however, the specific locations would be determined by drilling results and coordination with the Forest Service and other appropriate agencies.

Figure 2-3. Alternative 3 Conceptual Development Map.

2.2.3.4 Drilling Multiple Wells on an Individual Well Pad

Goal: To reduce well pad footprint and habitat fragmentation by reducing roads.

Description: Centralizing wells would allow the Operator to avoid drilling and maintaining wells near sensitive resources and maintain large areas of uninterrupted habitat, thereby reducing habitat fragmentation. With the use of the newest drilling rigs and techniques, directionally drilled wells no longer require larger well pads. With interim reclamation, the pad size could be reduced even further. This BMP should be evaluated for use in sensitive areas, such as slopes greater than 25% and crucial wildlife habitat.

2.2.3.5 Centralized Production Facilities

Goal: Fewer disturbances to wildlife from traffic.

Description: Run gathering lines (oil, gas, water, and condensate) where feasible, to centralized production facilities placed away from sensitive resources and habitat. Year-round truck traffic to each individual well would be significantly reduced.

2.2.3.6 Closed Loop Drilling

Goal: To reduce environmental impacts of drilling through ―closed loop" drilling techniques.

Description: Solid well cuttings are removed from the drilling fluid, and the drilling fluid is stored in tanks and re-used rather than being deposited in a waste pit. By eliminating the disposal pits, closed loop drilling systems can reduce closure and waste management costs, and reduce potential for contamination from leaking.

2.2.3.7 Installation of Raptor Perch Avoidance Devices

Goal: To discourage raptor perching on existing power poles and tank batteries.

Description: This BMP would reduce potential predation of Forest Service sensitive species, including greater sage-grouse. Proven anti-perching devices would be used. Also, perch avoidance mechanisms would reduce potential for electrocution of raptors that may perch on tank batteries or power poles.

2.2.3.8 Summary

If selected, Alternative 3 would allow the construction of up to 374 well pads, and the drilling of up to 400 wells using a combination of new and existing well with the above conditions applied to the development. Alternative 3 would approve the following:

- Requirements to submit PODs for concentrated areas of development prior to authorization. A separate POD would be required for development in mule deer crucial winter range habitat since these areas do not already have seasonal closures, per the lease stipulations.
- Requirement to consider the BMPs listed herein for application in each POD area or well location in addition to mandated application of the design elements listed in the Proposed Action. Documentation of reasoning why BMPs would not be incorporated in a POD would have to be approved by the Forest Service.
- No well locations would be placed on slopes greater than 25%. Drilling on up to 374 new well pads, with the remainder on existing pads, with the above provisions.

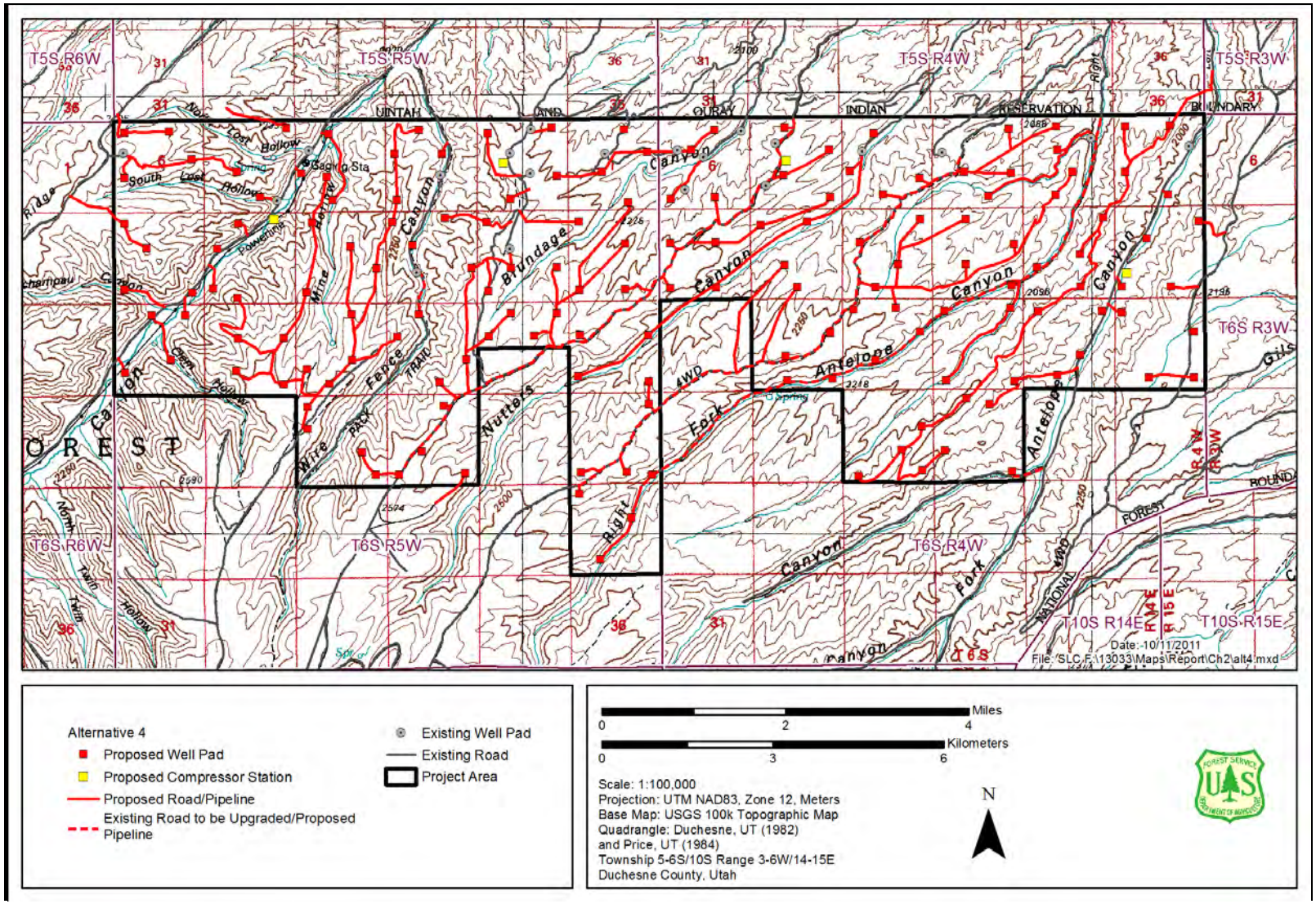
- Short-term and long-term surface disturbance would be approximately the same as the Proposed Action; however, short-term disturbance would be concentrated in smaller areas at any given time.
- All pipelines would be required to be buried under Alternative 3, except where determined otherwise by the Forest Service.

2.2.4 Alternative 4 (Preferred Alternative) – Minimize Surface Disturbance

The Forest Service selected this alternative as the Preferred Alternative because it would result in the least surface disturbance of all of the action alternatives. Alternative 4 would limit surface development to a maximum of 162 well pads (averaging four well pads per section), but up to six well pads per individual section where topography does not allow optimal center-of-quarter section pad placement (Figure 2-4).

All wells would be required to be drilled from those 162 well pads by use of techniques such as directional drilling. Alternative 4 would include the following:

- Drilling on up to 162 well pads (average of four well pads per section, and up to six well pads in any particular section). Downhole well spacing would not be limited and it is estimated that up to 400 downhole well bores would be drilled using a combination of new and existing well pads
- Assumes a 5- to 20-year drilling phase with two rigs running for the duration of the drilling phase, and 20 to 40 wells drilled per year.
- A total of 836 acres of short-term surface disturbance throughout the Project Area (including compressor stations) during the drilling phase.
  - Initially, each well pad could be 3 acres in size in order to accommodate multiple wells on the same well pad, for 836 acres of short-term disturbance.
  - 57 miles of new access road, and 20 miles of upgraded access road, with 327 acres of initial road disturbance. This includes 8 miles of new and upgraded roads that would extend beyond the Project boundary, outside of the Operator‘s lease area, as shown on Figure 2-4. All newly constructed roads would be closed to public motorized use.
  - 10,000 HP of additional compression in the field on four compressor stations (2,500 HP each). Each compressor station is estimated to cover 4 acres.
- A total of 411 acres long-term surface disturbance during the production phase (including compressor stations), after successful interim reclamation.
- 87 miles of gathering pipeline with the majority of pipelines co-located in access road ROWs.
  - No additional surface disturbance resulting from gathering pipelines.
  - Low-pressure lines would be poly pipe installed on the surface. High-pressure lines would be made of steel and buried.
  - In general, poly pipelines would be located on the surface, except as needed on a site-specific basis for safety reasons. Steel pipelines would be buried.



Disclaimer: This map depicts a conceptual development scenario only. Actual development is proposed to occur in a similar manner as depicted; however, the specific locations would be determined by drilling results and coordination with the Forest Service and other appropriate agencies.

Figure 2-4. Alternative 4 Conceptual Development Map.

2.2.5 Mitigation Common to All Alternatives

The Forest Service also developed the following mitigation measures to be applied to all of the action alternatives.

- Detailed site specific transportation plans will be submitted with each application to drill. Transportation plans will include detailed route locations, drawings, gates, signage, erosion control, drainage, road maintenance, etc.
- The mitigation measures listed in Section 2.2.2 (Proposed Action) would apply to all action alternatives, unless mitigation measures identified in other sections are more stringent. In those instances, the most stringent mitigation measure would apply.

  The Operator has committed to the following mitigation measures to reduce impacts to air quality. These measures apply to all of the action alternatives.

- The Operator would use drill rigs that meet the EPA Tier II emission standards or better for the LOP.
- The Operator would conduct green completions to minimize natural gas/methane and VOC emissions. A green completion involves capturing natural gas that initially flows from a well after flowback of water has finished. Historically, for the first few days after a well is completed, natural gas is vented to the atmosphere until all residual hydraulic fracturing sand and water has blown out of the well. The Operator would direct natural gas flowing from newly completed wells into the sales pipeline, or use it for fuel gas for on-site heaters and the pump jack engine. This is accomplished using a separator to separate water, sand, oil, and gas initially coming out of the well.
- The Operator would install pump jack engines that meet the applicable New Source Performance Standards (NSPS) emission limits for pump jack engines.
- The Operator would install emission controls on condensate tank batteries and dehydrators with control efficiencies of greater than 95%.
- The Operator would test the efficiency of controls annually and ensure that flaring/combustors meet >90% efficiency.
- The Operator would install viton/teflon seals for chemical and cold weather service (Enardo thief hatches and Stack Vents) on hatches and valves.
- The Operator would install three phase separators on its gas pipelines at the compressor stations, which would stabilize the natural gas liquids at a much lower pressure, and would re-route the majority of VOC flash emissions back into the gas pipeline, instead of dumping them into the condensate tanks, which are at atmospheric pressure. The resulting reroute of the VOC flash gas into the gas pipeline and reduced pressure drop at the condensate tanks would greatly reduce VOC flash emissions at the tanks.
- The Operator would ensure that the design of VOC collection systems (piping, valves, etc.) are adequate for control systems for the LOP.
- The Operator would install low/no bleed pneumatic controllers and valves on all new equipment.
- The Operator would route pneumatic pump emissions to either emission control devices, or back into the process stream to eliminate emissions. The majority of pneumatic emissions would be generated by the glycol dehydration pumps at about 18 tons per year per compressor station. These emissions would be 95% controlled,

yielding 0.9 ton per year controlled VOC emissions per station. As an alternative, pneumatic pump emissions may be re-directed back into the process stream and controlled 100%.

- The Operator would install secondary control systems on project-related compressor engines to reduce emissions. Potential secondary control systems include the following.
  - Installation of new ultra lean burn engines with oxidation catalysts and turbochargers. These engines have been engineered to significantly reduce emissions through air-fuel ratio modifications, modified piston design, and utilize oxidation catalysts as a secondary control measure to further reduce emissions from the engines.
  - Installation of rich burn engines equipped with three-way catalysts as a secondary control measure. These engines with the secondary control device can achieve substantially lower emissions than older engines not equipped with secondary controls.
- The Operator will drill multiple wells on individual pads where feasible. Production facilities will also be consolidated when possible, to reduce disturbance from traffic, habitat fragmentation, and total surface area impacts.
- The Operator would recycle/reuse approximately 70% of produced water generated by the project, using it both for drilling and completions of new wells, or for other off-site projects. The remaining 30% of produced water would be sent to a permitted disposal facility, which would reduce hydrocarbon evaporation emissions by approximately 70%.
- The Operator would implement a leak detection program that is consistent with EPA Method 21, once gas production has ramped up to the point where compression is needed. Leak detection surveys would be conducted on a quarterly basis, the results documented, and repairs made on a timely basis where leaks are detected. A Leak Detection Plan would be submitted to the Forest Service and/or EPA for approval. EPA Method 21, ―Determination of Volatile Organic Compound Leaks," is a standard protocol used by a variety of industries nationwide for the detection of gas leaks at their facilities. For the oil and gas industry, natural gas/VOC leak detection is typically done on equipment that transports or processes gas. Examples include the well heads, at the compressors, valves, pipeline fittings, threaded connections, flanges, pressure relief devices, and pump seals. The method requires use of a portable vapor detection device, such as an Organic Vapor Analyzer, that is properly calibrated to sample the air around connections and equipment where leaks could occur. Typically a leak detection limit is defined. If the instrument measures a gas concentration above this limit, the sampled location is considered to have a leak. The Operator would most likely utilize a third-party contractor to perform the surveys, using an approved leak detection instrument. The leak detection limit would be 10,000 parts per million (ppm) of methane. If a leak is discovered during an inspection, the leaking piece of equipment would be tagged, and the appropriate personnel would be notified. The tag would remain in place until the leak is repaired and re-sampled to verify the leak is no longer occurring. Leaks at or above 10,000 ppm would be repaired within 15 days. An exception to this repair schedule would be if the leak is occurring on an essential component, where the repair would require the shutdown of a critical process unit that would affect operation of the proposed project. An example would be the shutdown of a compressor serving 25% of the field. If a leak above 10,000 ppm is discovered on a

critical process unit, the leak would be repaired during the next scheduled shut down of the equipment for maintenance or other repairs, but would not exceed one year from the date of leak discovery. Leak findings and repairs would be documented.

- The Operator would install and operate an ozone monitoring station southwest of Roosevelt, Utah, on Operator-owned property. The ozone monitoring program would be consistent with those managed by the State of Utah and the EPA in the Uintah Basin, and data collected would be provided to the State and the EPA.

2.3 Alternatives Considered but Eliminated from Detailed Study

Federal agencies are required by NEPA to rigorously explore and objectively evaluate all reasonable alternatives and to briefly discuss the reasons for eliminating any alternatives that were not developed in detail (40 CFR 1502.14). Public comments received in response to the Proposed Action provided suggestions for alternative methods for achieving the purpose and need. Some of these alternatives were outside the scope of the action considered at this time, duplicative of the alternatives considered in detail, or determined to be components that would be impractical or unfeasible. Therefore, a number of alternatives were considered, but dismissed from detailed consideration for reasons summarized below.

2.3.1 648 Well Pads in Project Area

An alternative was considered to allow full field development with wells drilled throughout the Project Area on 40-acre spacing. It was suggested that this alternative would represent a cumulative potential reasonable foreseeable development scenario. This alternative would result in drilling up to 648 wells in the Project Area, a 60% increase over the Proposed Action. Surface disturbance for well pads was assumed to be 2.5 acres each, the same as the Proposed Action. This alternative was eliminated from further analysis because it was determined by the Forest Service that this level of development is not reasonably foreseeable and would result in increased impacts to resources above the Proposed Action.

2.3.2 Cap on Surface Disturbance

Placing a cap on acres of surface disturbance to be allowed in the Project Area was considered. This would entail limiting surface disturbance while not restricting the number of well pads or roads allowed over the LOP. This concept was not brought forward for detailed analysis because the Proposed Action and other alternatives already provide reasonable restrictions to surface disturbance and also restrict the number of wells and miles of roads that may be developed. The Forest Service determined that placing a cap on surface disturbance would be impractical from a long-term management perspective.

2.3.3 Secondary Oil Recovery

Secondary oil recovery was raised as an alternative component in scoping comments. This was determined to not meet the purpose and need. Secondary oil recovery was not proposed by the Operator and is beyond the scope of the Proposed Action. It would also

be more impactful than the Proposed Action. The Forest Service would conduct supplemental NEPA analysis at a later time if secondary oil recovery were proposed.

2.3.4 Horizontal Drilling

The feasibility of extracting oil and gas resources through horizontal drilling technology was evaluated in the Reasonable Foreseeable Development Scenario (RFDS) (Engler and Cather 2007). The RFDS determined that horizontal drilling is not technically feasible due to the nature and depth of the target formations. If technology changes, the Operator would still have the option to use this technique to extract the oil and gas reserves in the future.

2.3.5 Inventoried Roadless Area No Surface Occupancy

An alternative was considered, which would limit surface disturbance within IRAs, by placing a no surface occupancy (NSO) stipulation on IRAs within the Project Area. Such an alternative could reduce project-related impacts to IRAs within the Project Area, including roadless characteristics such as undeveloped. However, lease stipulations are generally developed as part of leasing decisions, prior to actual issuance of oil and gas leases, and are attached to individual oil and gas leases at the time of lease sales. The decision for the 1997 Western Uintah Basin Oil and Gas Leasing EIS allowed large parts of the South Unit of the ANF to be open for oil and gas leasing, and identified the lease stipulations to be applied, including several NSO stipulations to be applied to certain areas. Following the leasing decision, the BLM leased some of the South Unit for oil and gas development, including lands and leases inside the Project Area. Within reasonable limits, those leases give the lease holders a legal right to develop those leases, for the production of oil and gas resources. Adding additional NSO stipulations to existing oil and gas leases and proposed oil and gas developments, outside the formal leasing decision, and after the leases have already been sold, violates the terms of the leases in question. Creating additional NSO stipulations, for IRAs within the Project Area, could potentially eliminate as many as 258 of the 374 proposed well pad locations, and eliminate road construction to those locations, thereby preventing needed and reasonable access to the minerals already leased within those areas. Preventing reasonable access in these areas would therefore prevent the lease holder from developing existing lease rights and would be contrary to the Mineral Leasing Act and the purpose and need for the project. Therefore, this alternative was eliminated from further analysis.

The Forest Service has considered various tools and technologies, including the use of directional drilling, and having multiple wells per well pad, in order to minimize surface disturbance throughout the Project Area, including impacts to IRAs. Existing roads are proposed for use, wherever possible, to minimize the need for additional roads, and needed production pipelines have been co-located alongside existing or proposed roads, in order to further minimize surface disturbances and development corridors. These tools have been incorporated into the Preferred Alternative in an attempt to minimize impacts to the extent reasonably possible. Other potential mitigation (horizontal drilling, helicopter supported drilling, cross-country travel, use of temporary lower-quality roads) were also considered as options, but were not deemed feasible because of safety issues, locally rugged surface topography, depth of drilling targets compared to available drilling technology, size and mobility of needed drilling equipment, and the expected long-term nature of the proposed developments.

2.4 Comparison of Alternatives

This section provides a summary of the effects of implementing each alternative. Information in Tables 2-1 and 2-2 is focused on activities and effects where different levels of effects or outputs can be distinguished quantitatively or qualitatively among alternatives.

Table 2-1. Comparison of Alternatives.

Description of Activity	Alternative 1 No Action	Alternative 2 Proposed Action	Alternative 3	Alternative 4 Preferred
Approximate Number of New Well Pads[1]	0	374	374	162
Approximate Number of Wells (Downhole) includes new and existing wells	0	400	400	400
Miles of New Roads	0	77	77	57
Miles of Gathering Pipelines[2]	0	107	107	87
Miles of Upgraded Roads[2]	0	20	20	20
Number of New Compressor Facilities	0	4	4	4
New Well Pads Per Year	0	10–50	10–50	20–40
Drilling Phase (Years)	0	5–20	5–20	5–20
Production/Interim Reclamation Phase (Years)	0	50	50	50
Final Reclamation Phase (Years)	0	5	5	5
Life-of-Project (LOP) (Years)	0	55	55	55
LOP New Surface Disturbance Acres	0	1,361	1,355	836
Acres of New Well Pads	0	935	935	493
Acres of New and Upgraded Roads and Gathering Pipelines[2]	0	410	410	327
Acres of New Compressor Facilities	0	16	16	16

LOP Long-term Disturbance (after interim reclamation) - Acres	0	595	590	411
LOP Long-term Disturbance - Percent of Project Area	**0%**	**2.3%**	**2.3%**	**1.6%**
Total Long-term Disturbance - Acres	**168**	**763**	**758**	**579**
Total Long-term Disturbance - Percent of Project Area	**0.6%**	**2.9%**	**2.9%**	**2.2%**

[1]The 400 well pads analyzed in the DEIS was reduced to 374 new well pads.

[2]Includes approximately 8 miles (33 acres) of new and upgraded roads that would extend outside of the Project Area (the Operator's lease area), then loop back into Project Area. This area is included in the impacts analysis for each resource in Chapter 3.

Table 2-2. Comparison of Impacts by Alternative.

Resource	Alternative 1 No Action	Alternative 2 Proposed Action	Alternative 3	Alternative 4
Climate and Air Quality	No new direct or indirect impacts beyond that which has already been approved.	Modeled near-field and far-field impacts in compliance with ambient air quality standards. Impacts from hazardous air pollutants below toxic screening levels and reference concentrations. No detrimental impacts to visibility and no deposition levels above Forest Service levels of concern. Ozone impacts mitigated through Operator-committed measures.	Same as the Proposed Action	Same as the Proposed Action
Geology and Minerals	No new direct impacts to surface or topography. Extraction of oil/gas continuing only from the previously approved wells.	Initial 1,361 acres surface disturbance reduced to 595 acres after interim reclamation. Drilling 400 wells, for full depletion of oil/gas resources within the target formation. No well pads on slopes greater than 35%.	Initial 1,355 acres surface disturbance reduced to 590 acres after interim reclamation. Limited well locations on slopes greater than 25%. Full depletion of oil/gas resources within the target formation.	Initial 836 acres surface disturbance reduced to 411 acres after interim reclamation. Would not exceed 162 well pads. Full depletion of oil/gas resources within the target formation. No well pads on slopes greater than 35%.

Resource	Alternative 1 No Action	Alternative 2 Proposed Action	Alternative 3	Alternative 4
Paleontological Resources	No new direct impacts. Indirect effects from public access to fossils via **existing** travel routes.	796 acres surface disturbance within Class 5 geologic units; 391 acres within Class 4; 51 acres within Class 3; and 123 acres within Class 2. Mitigation to avoid or recover and preserve resources.	790 acres surface disturbance within Class 5 geologic units; 380 acres within Class 4; 30 acres within Class 3; and 155 acres within Class 2. Limited well locations on slopes greater than 25% reduces fossiliferous rock disturbed. Mitigation to avoid or recover and preserve resources.	501 acres surface disturbance within Class 5 geologic units; 211 acres within Class 4; 29 acres within Class 3; and 94 acres within Class 2. Mitigation to avoid or recover and preserve resources.
Soils	No new direct impacts to surface and soils.	1,361 acres surface disturbance. Soils from well pads stockpiled for use in reclamation.	1,355 acres surface disturbance. Soils from well pads stockpiled for use in reclamation.	836 acres surface disturbance. Soils from well pads stockpiled for use in reclamation.
Surface Water and Groundwater	No new impacts to surface water or groundwater.	7.5 miles of surface disturbance to intermittent streams, 0.3 mile of disturbance to perennial stream, and 1,361 acres of surface disturbance. No depletions, diversions, or groundwater wells within the project area.	8.3 miles of surface disturbance to intermittent streams, 0.4 mile of surface disturbance to perennial stream, and 1,355 acres of surface disturbance. No depletions, diversions, or groundwater wells.	3.4 miles of surface disturbance to intermittent streams, 0.2 mile of surface disturbance to perennial stream, and 836 acres of surface disturbance. No depletions, diversions, or groundwater wells.

Resource	Alternative 1 No Action	Alternative 2 Proposed Action	Alternative 3	Alternative 4
Wetlands and Floodplains	No new impacts to riparian areas or wetlands.	No significant impacts to wetlands, waters of the U.S., or riparian areas with implementation of BMPs. Road and pipeline crossings may impact wetland/ riparian vegetation, but would be analyzed by the U.S. Army Corps of Engineers permit process.	Same as the Proposed Action.	Same as the Proposed Action.
Vegetation	No new impacts to vegetation.	Initially 5% of pinyon-juniper habitat would be disturbed, reduced to 2% after interim reclamation.	Similar to Proposed Action. Impacts to vegetation communities reduced at any one time as reclamation and weed control would occur immediately following well completion.	Initially 2.6% of pinyon-juniper habitat would be disturbed, reduced to 1.8% after interim reclamation. Collocation of wells would decrease surface disturbance and potential introduction of noxious and invasive weeds.

Resource	Alternative 1 No Action	Alternative 2 Proposed Action	Alternative 3	Alternative 4
Noxious Weeds	No new impacts to vegetation from noxious weeds. Present populations of weeds may persist or increase without additional weed monitoring.	Increased potential for introduction of noxious/invasive plants. Weed control would occur immediately following well completion.	Similar to Proposed Action. Weed control would occur immediately following well completion.	Similar to Proposed Action. Collocation of wells would decrease potential introduction of noxious and invasive weeds along roads. Weed control would occur immediately following well completion.
Sensitive Plant Species	No new impacts to Forest Service sensitive plant species.	No direct impacts as known populations would be avoided. Indirect impacts from fugitive dust and loss of habitat.	Same as the Proposed Action.	Reduced potential for impacts compared to Proposed Action due to reduced surface disturbance.
Threatened, Endangered, and Sensitive Wildlife Species	No new impacts to wildlife.	Direct and / or indirect impacts to suitable habitat for spotted bat, Townsend‘s big-eared bat, and flammulated owl, three-toed woodpecker, goshawk, and greater sage-grouse. Indirect impacts to greater sage-grouse.	Same as the Proposed Action.	Reduced potential for impacts compared to Proposed Action due to reduced surface disturbance and mitigation measures. Decreased vehicle impacts.

Resource	Alternative 1 No Action	Alternative 2 Proposed Action	Alternative 3	Alternative 4
Management Indicator Species	No new impacts to Forest Service management indicator species.	Direct and / or indirect impacts to suitable habitat for greater sage-grouse, golden eagle, Lincoln‘s sparrow, song sparrow, red-naped sapsucker, warbling vireo, goshawk, and macroinvertebrates, and known mule deer and Rocky Mountain elk winter and summer ranges.	Similar to the Proposed Action. Phased construction/drilling would provide larger, disturbance-free areas for foraging and migration.	Reduced potential for impacts compared to Proposed Action due to reduced surface disturbance and mitigation measures. Decreased vehicle impacts.
Migratory Birds	No new impacts to migratory birds.	Long-term disturbance to 2.1% of pinyon-juniper habitat, 3.4% of sagebrush habitat, and 7.4% of riparian habitat in the Project Area.	Long-term disturbance to 2.0% of pinyon-juniper habitat, 3.8% of sagebrush habitat, and 8.2% of riparian habitat in the Project Area. Phased construction/ drilling would provide larger, disturbance-free areas for foraging and nesting.	Reduced potential for impacts compared to Proposed Action due to reduced surface disturbance and mitigation measures. Decreased vehicle impacts. Long-term disturbance to 1.5% of pinyon-juniper habitat, 3.1% of sagebrush habitat, and 5.7% of riparian habitat in the Project Area. Decreased vehicle impacts.

Resource	Alternative 1 No Action	Alternative 2 Proposed Action	Alternative 3	Alternative 4
Livestock Grazing	No new impacts to livestock grazing allotments.	Surface disturbance to 1,361 acres or 5% of the total land area of the grazing allotments within the Project Area, with a majority of disturbance in the Anthro Mountain allotment, reduced to 589 acres of the total allotments after reclamation.	Similar to the Proposed Action. Phased construction/drilling would reduce impacts to allotments at any one time as reclamation would occur immediately following well completion.	Surface disturbance of 836 acres or 3% of the total land area of the grazing allotments within the Project Area, with the majority of disturbance in the Anthro and Antelope allotments, reduced to 458 acres of the total allotments after reclamation. Collocation of wells would decrease potential introduction of noxious and invasive weeds along roads.
Cultural Resources	No new impacts to cultural resources. Areas would remain unsurveyed and the resources would remain unrecorded.	Greatest potential for impact to existing cultural resources. High well pad density limits options for avoiding sites and may require more intensive treatments. Greatest visual impacts to any identified traditional cultural properties.	Similar to the Proposed Action. Phased approach would reduce visual impact at any one time.	Reduced potential for impacts compared to Proposed Action. Collocation of wells would decrease potential impacts to resources and temporary visual impacts.

Resource	Alternative 1 No Action	Alternative 2 Proposed Action	Alternative 3	Alternative 4
Recreation	No new impacts to dispersed or commercial recreation. No new access or motorized opportunities would be developed.	Opportunities for solitude, remoteness, and backcountry travel would be reduced. Loss of unroaded areas, habitat fragmentation, and increased human activity would impact outfitters.	Similar to the Proposed Action. Phased approach would allow undisturbed recreation in certain areas until the final phase.	Reduced potential for impacts compared to Proposed Action. Collocation of wells would decrease potential impacts from road development.
Potential Wilderness	No additional activities would occur in any potential wilderness or inventoried roadless area other than those previously approved for the Project Area.	Some wilderness attribute conditions exhibited by the Wilderness Potential Areas in the Project Area would be altered. The Nutters Canyon Potential Wilderness Area (# 401409) would no longer demonstrate wilderness attributes and potential and would no longer be considered in future potential wilderness inventories.	Same as the Proposed Action.	Reduced potential for impacts compared to Proposed Action due to reduction in surface disturbance.
Visual Resources	No new impacts to visual resources.	Wells, drilling rigs, roads, pipelines, and compressor stations visible from hiking trails and other viewpoints. In compliance with designated Modification VQOs.	Same as the Proposed Action.	Reduced potential for impacts compared to Proposed Action.

Resource	Alternative 1 No Action	Alternative 2 Proposed Action	Alternative 3	Alternative 4
Transportation	No new or improved roads. No change in traffic levels.	77 miles of new access roads and upgrading 20 miles of existing roads. 161 light truck trips and 186 heavy truck trips / well drilled during construction / drilling phase. New access roads not open to public use.	Similar to the Proposed Action. Roads would be constructed in phases. Strategies would be developed to reduce traffic. New access roads not open to public use.	57 miles of new access roads and upgrading 20 miles of existing roads. Collocation of wells would decrease truck trips. New access roads not open to public use.
Socioeconomics	No impact to population or demographics. No additional employment or change in local economy.	Minor temporary increase in population. Increased employment and economic activity for the LOP. Positive impact on taxes and revenues.	Same as the Proposed Action.	Same as the Proposed Action.
Environmental Justice	No impact.	Potential disproportionate impacts to low-income populations in terms of housing costs.	Same as the Proposed Action.	Same as the Proposed Action.

CHAPTER 3.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

3.1 Introduction

This chapter summarizes the existing physical, biological, social, and economic environments of the Project Area and the effects of implementing each alternative on those environments. Also included is the scientific and analytical basis for the comparison of alternatives presented in Chapter 2. While many elements of the Proposed Action and alternatives are well-defined, the specific locations and number of wells that would ultimately be developed are yet to be determined. For the purposes of this analysis, certain assumptions have been made to develop a conceptual scope and pattern of well development for each action alternative. This allows potential environmental impacts to be identified and evaluated.

The potential impacts of construction, drilling, completion, operation, and reclamation of the project are presented for each affected resource under each alternative. Each resource area discussion in this chapter includes sections on the Affected Environment; Environmental Consequences, including direct, indirect, and cumulative impacts; and Mitigation. It is assumed that Operator-committed mitigation, design elements, and BMPs included in alternatives descriptions in Chapter 2 would be implemented to avoid or minimize impacts. Mitigation measures included in Chapter 2 are not repeated in the Mitigation sections in Chapter 3.

This chapter also discusses cumulative impacts to each resource. Cumulative impacts are those that result from the incremental impacts of an action added to other past, present, and reasonably foreseeable actions (RFAs), regardless of what agency (federal or non-federal) or person undertakes such actions. Cumulative impact assessment includes past, present, and reasonably foreseeable development, such as other oil and gas projects in the Uintah Basin. Agencies look for present effects of past actions that are, in the judgment of the agency, relevant and useful because they have a significant cause-and-effect relationship with the direct and indirect effects of the proposal for agency action and its alternatives (36 CFR 220.4 [f]). Cumulative actions can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7). The cumulative impact analysis areas (CIAAs) for past and present actions, as well as RFAs that may generate cumulative impacts, vary depending on the resource under consideration. For example, air quality is regional in nature; therefore, the CIAA and scope of activities considered is necessarily broad. In contrast, the CIAA for minerals is the Project Area itself; therefore, the scope of potential cumulative activities considered is much narrower. The extent of individual CIAAs for this EIS is described in each resource section.

Table 3-1 identifies the land use planning and environmental documents consulted in determining the pertinent existing and RFAs in the Uintah Basin. Oil and natural gas development has been an ongoing resource use in the Uintah Basin since the early 1900s. Other land uses in the Uintah Basin include mining, livestock grazing, and recreation. RFAs include continued oil and gas development projects; development of tar sands, gilsonite, oil shale, phosphate, mineral materials (sand, gravel, and building stone), locatable minerals (gold and uranium), and coal; livestock management prescriptions;

development of recreation areas; and vegetation treatments. Figure 3-1 illustrates the existing and RFAs in relation to the Project Area.

Table 3-1. Land Use Planning and Environmental Documents Consulted in Determining the Pertinent Existing and Reasonably Foreseeable Actions in the Uintah Basin.

Project	Activity
Gasco Uinta Basin Natural Gas Field Development Project EIS	Up to 1,538 wells, 400 miles of roads, and 525 miles of pipelines proposed for up to 10,302 acres of surface disturbance. BLM issued Draft EIS October 2010.
Kings Canyon Unit Leasing and Field Development	Leasing and development strategies proposed within the Greater King‘s Canyon Project Area.
XTO Little Canyon Project Area Natural Gas Development EA	510 wells drilled from 362 well pads with 148 of the wells drilled directionally proposed on 40-acre spacing on 32,000 acres, 1,882 acres of surface disturbance proposed. BLM issued draft EA in February 2008.
Vantage Energy Oil and Gas Exploration EA	Proposed exploration and developments affecting 15 wells (some newly proposed, some previously approved, and some already drilled), on leases immediately south of the South Unit Project Area. Forest Service issued an EA and FONSI in January 2011 (Forest Service 2011), however, the FONSI was later withdrawn. The exploration and development proposal is still under Forest Service review.
Gardner Canyon Stewardship Project EA	BLM 600-acre forest restoration, reforestation, and salvage EA.
Castle Peak and 8-Mile Flat Oil and Gas Expansion Project EIS	Oil and gas development EIS for Castle Peak and 8-Mile Flat area, completed in 2005. Approved up to 900 wells and 3,700 acres of surface disturbance.
Gasco 2-D Seismic	2-D seismic exploration EA, completed in 2007.
Wilkin Ridge Natural Gas Expansion Project EA	Oil and gas development EA, completed in 2007. Approved drilling of up to 54 wells and construction of 21 miles of roads.
West Tavaputs Plateau Natural Gas Field Development EIS	Up to 807 wells proposed and 2,310 acres of surface disturbance. Final EIS and ROD issued July 2010.

Project	Activity
Rye Patch Exploratory Drilling EA	Approved seven wells, a compressor station, and 11.4 miles of road upgrades. EA completed in 2007.
Monument Butte I, II, and Waterflood	Oil and gas field development EAs, completed in 1993, 1995, and 1997, respectively.
Antelope Creek Field Development	BIA oil and gas development EA, completed in 1995.
Brundage Canyon Field Development	BIA oil and gas development EA, completed in 1997.
Leland Bench Oil Field Development	Oil field development EA, completed in 1995.
Greater Chapita Natural Gas Wells Infill EIS	Up to 7,028 wells proposed from 700 well pads on 20-acre spacing for approximately 5,688 acres of surface disturbance. BLM‘s public scoping ended in October 2009.
Chapita Wells-Stagecoach Area Natural Gas Development EIS	Up to 627 natural gas wells (473 wells from new well pads, 154 from existing) with the majority of wells on 40-acre density. BLM signed ROD in 2008 approving 1,735 acres of surface disturbance.
Greater Natural Buttes EIS	Up to 3,496 wells with an estimated 7,804 acres of surface disturbance. BLM issued draft EIS July 2010 and supplemental draft EIS May 2011.
Enduring Resources Big Pack EA	Up to 664 wells from 292 well pads, with an estimated 1,620 acres of surface disturbance. BLM issued EA in 2008, but not finalized.
XTO Riverbend Unit Expansion Project EA	Up to 378 wells drilled from 169 existing well pads which would be expanded and 128 well from 74 new well pads, with an estimated 1,103 acres of surface disturbance. BLM issued draft EA in 2008. Second public scoping period in fall 2011 for new air model.

Project	Activity
XTO Hill Creek Unit EA	Up to 137 natural gas wells from 101 existing well pads which would be expanded and 7 wells from 7 new well pads, for an estimated 70 acres of surface disturbance. Draft EA April 2009.
Greater Deadman Bench Oil and Gas Producing Region EIS	Up to 891 wells on new locations and 346 on existing locations. ROD signed in 2008 approved up to 4,561 acres of disturbance.

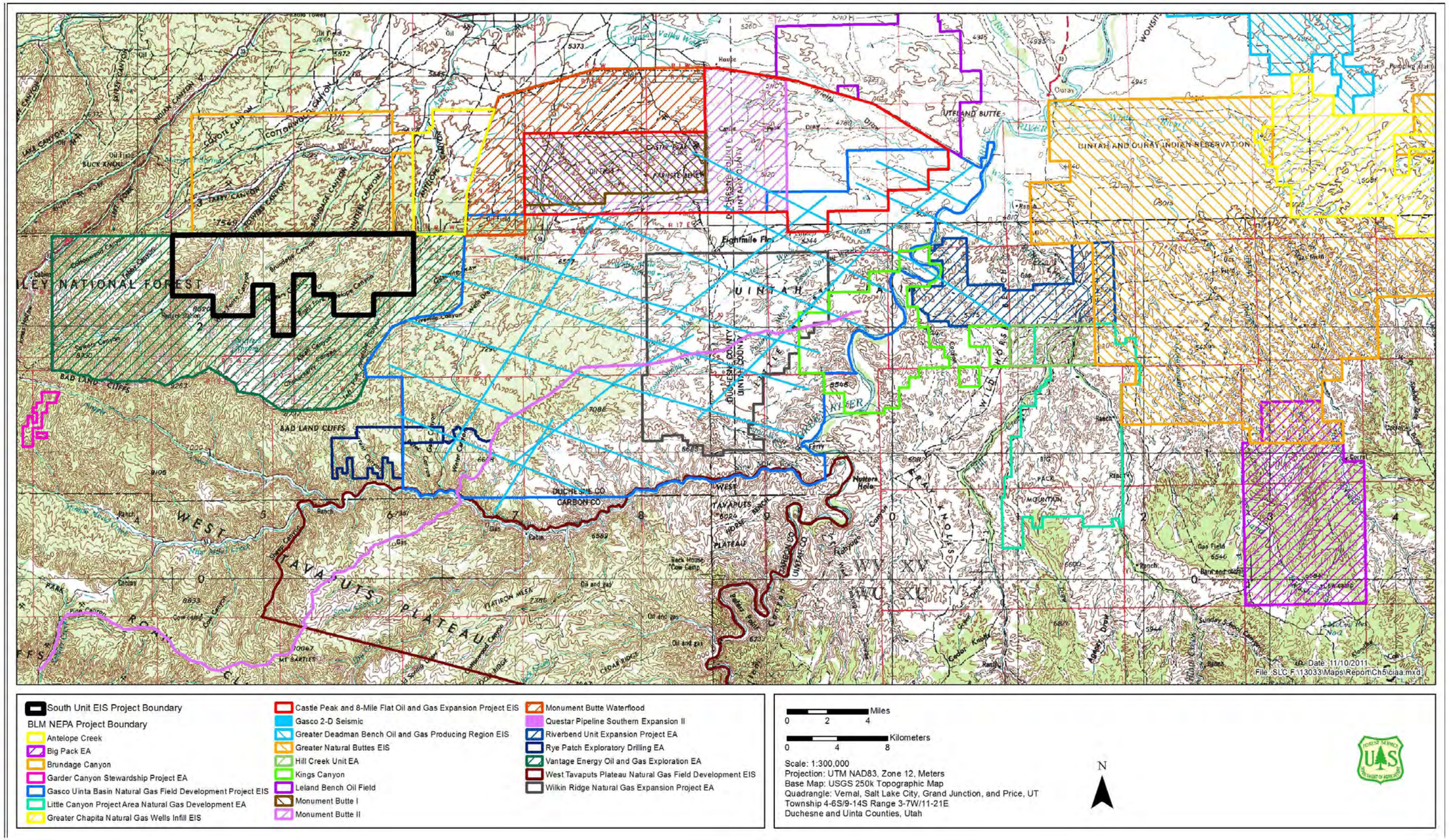


Figure 3-1. Existing and Reasonably Foreseeable Actions in the Vicinity of the Project Area.

3.2 Climate and Air Quality

3.2.1 Affected Environment

Regional air quality is influenced by a combination of factors including climate, meteorology, the magnitude and spatial distribution of local and regional air pollution sources, and the chemical properties of emitted pollutants. Within the lower atmosphere, regional and local scale air masses interact with regional topography to influence atmospheric dispersion and transport of pollutants. The following sections summarize the climatic conditions and existing air quality within the Project Area and surrounding region.

The Project Area is located on the West Tavaputs Plateau in the southern foothills of the Uintah Basin in a semiarid mid-continental climate regime typified by dry windy conditions and limited precipitation. The Uintah Basin is bordered by the Wasatch Range to the west, which extends north and south through the middle of the state, and the High Uinta Mountains to the north, which extend east and west through the northeast portion of the state. Elevation of the Project Area ranges from 6,375 feet above mean sea level (amsl) in the northern portion to over 8,000 amsl in the southern portion.

3.2.1.1 Climate

The closest climate measurements to the Project Area were recorded at Nutters Ranch, Utah (1963–1986). The Nutters Ranch station is located 9.5 miles south of the Project Area at an elevation of 5,790 amsl (Western Regional Climate Center [WRCC] 2008). Table 3-2 summarizes the mean temperature range, mean total precipitation, and mean total snowfall by month.

Prevailing large-scale westerly air masses originating from the Pacific Ocean are typically interrupted by the western mountain ranges before reaching the Uintah Basin. As a result, the lower elevations of the Uintah Basin receive relatively slight amounts of precipitation while the higher elevations of the area generally receive larger amounts of precipitation. The annual mean precipitation at Nutters Ranch is 11.6 inches, and ranges from a minimum of 6.4 inches recorded in 1974, to a maximum of 24.8 inches recorded in 1965. On average, February is the driest month with a monthly mean precipitation of 0.5 inch, and August is the wettest month with a monthly mean precipitation of 1.4 inches. The annual average snowfall is 45.6 inches. December, January, February, and March are typically the months of highest snowfall. A maximum annual snowfall of 102 inches was recorded in 1965.

The surrounding area has an annual mean temperature of 46 degrees Fahrenheit (F). However, abundant sunshine and rapid nighttime cooling result in a wide range in daily temperature. Wide seasonal temperature variations typical of a mid-continental climate regime are also common. Average winter temperatures range from 9 to 38 degrees F, while average summer temperatures range from 50 to 85 degrees F. Recorded daily extreme temperatures are minus 25 degrees F in 1971 and 100 degrees F in 1976.

Table 3-2. Temperature, Precipitation, and Snowfall at Nutters Ranch, Utah (1963–1986).

Season	Month	Average Temperature Range (in degrees Fahrenheit)	Average Total Precipitation (inches)	Average Total Snowfall (inches)
Spring	March	22.4–51.6	1.2	6.1
	April	29.8–61.4	1.0	4.1
	May	38.5–71.9	1.1	0.6
	Total	30.3–61.6	3.3	10.8
Summer	June	46.4–81.3	0.9	0.0
	July	53.6–87.7	1.2	0.0
	August	51.3–85.4	1.4	0.0
	Total	50.4–84.8	3.4	0.0
Fall	September	42.2–77.1	1.1	0.5
	October	31.2–65.3	1.2	1.3
	November	20.1–49.4	0.7	5.4
	Total	31.2–63.9	3.0	7.2
Winter	December	9.2–36.6	0.9	12.4
	January	6.4–35.3	0.6	6.1
	February	11.5–42.0	0.5	9.0
	Total	9.0–38.0	1.9	27.6
Total		**30.2–62.1**	**11.6**	**45.6**

Source: WRCC (2008). Data collected at Nutters Ranch, Utah, from 1963 to 1986.

3.2.1.2 Winds and Atmospheric Stability

The transportation and dilution of air pollutants are primarily a function of wind speed and direction. Winds dictate the direction in which pollutants are transported. As wind speed increases, the dispersion of emitted pollutants also increases, thereby reducing pollutant concentrations.

Wind data within the Project Area have not been directly measured. Local terrain effects will influence the wind profiles specific to the Project Area. However, representative wind speed and direction data for the area are available at Bonanza, Utah, for the years 1985, 1986, 1987, and 1992. Figures 3-2 through 3-5 present a wind rose depicting wind speed and direction for all four years of data. Note that the data represent the direction from which the wind is blowing (Wind Direction Origin). For example, winds blowing from the north would transport pollutants to the south.

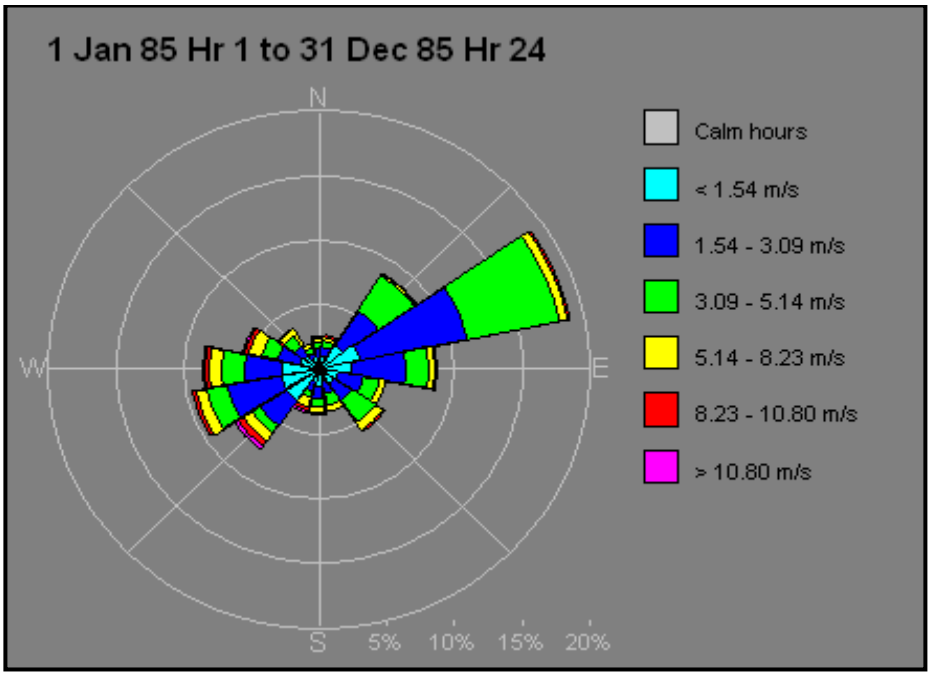


Figure 3-2. Wind Rose for 1985 Data Used in the Near-field Modeling.

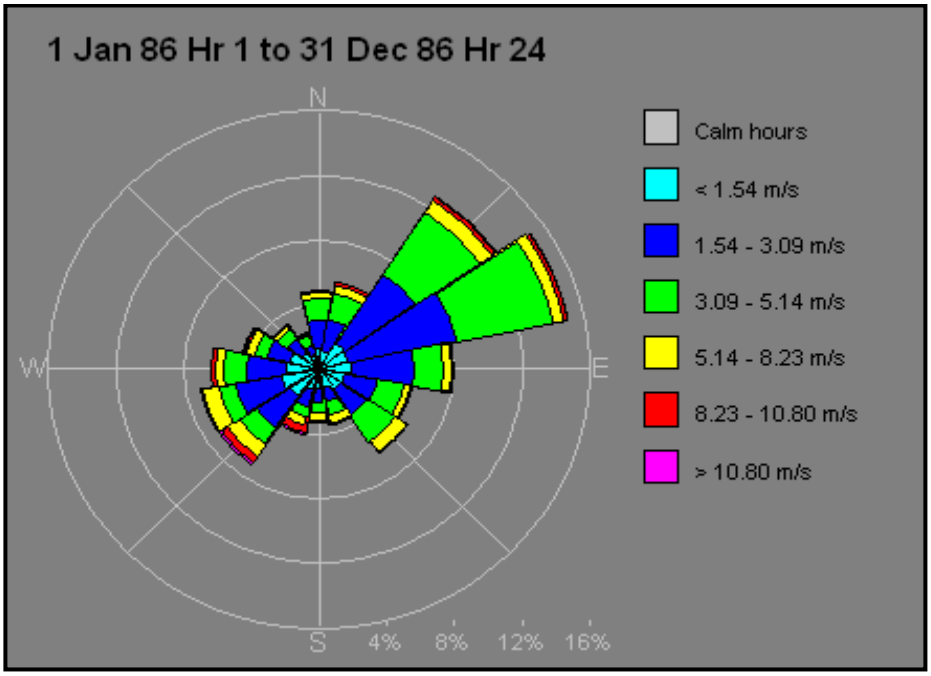


Figure 3-3. Wind Rose for 1986 Data Used in the Near-field Modeling.

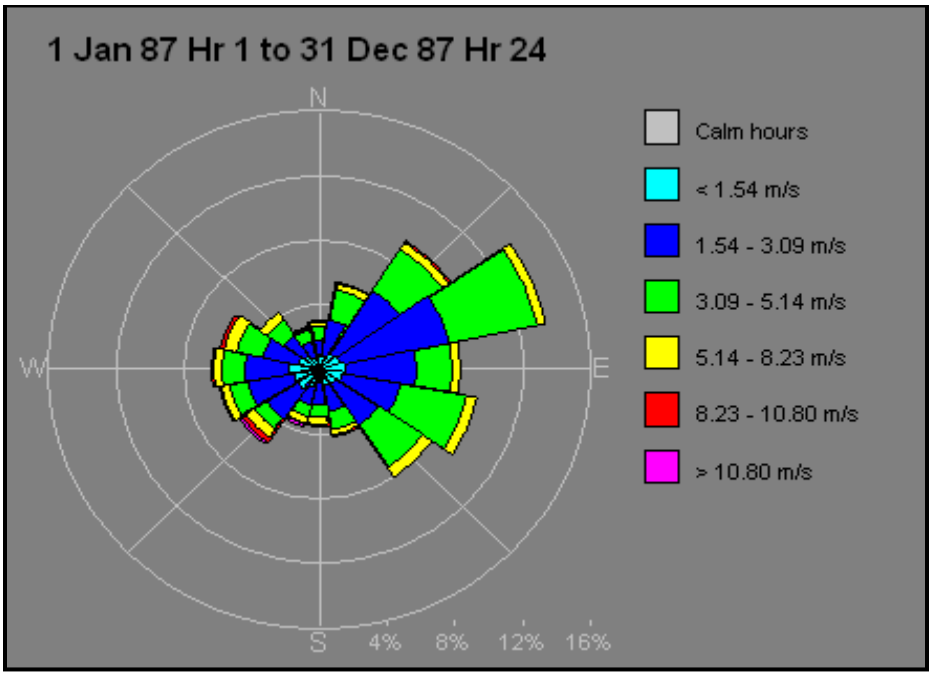


Figure 3-4. Wind Rose for 1987 Data Used in the Near-field Modeling.

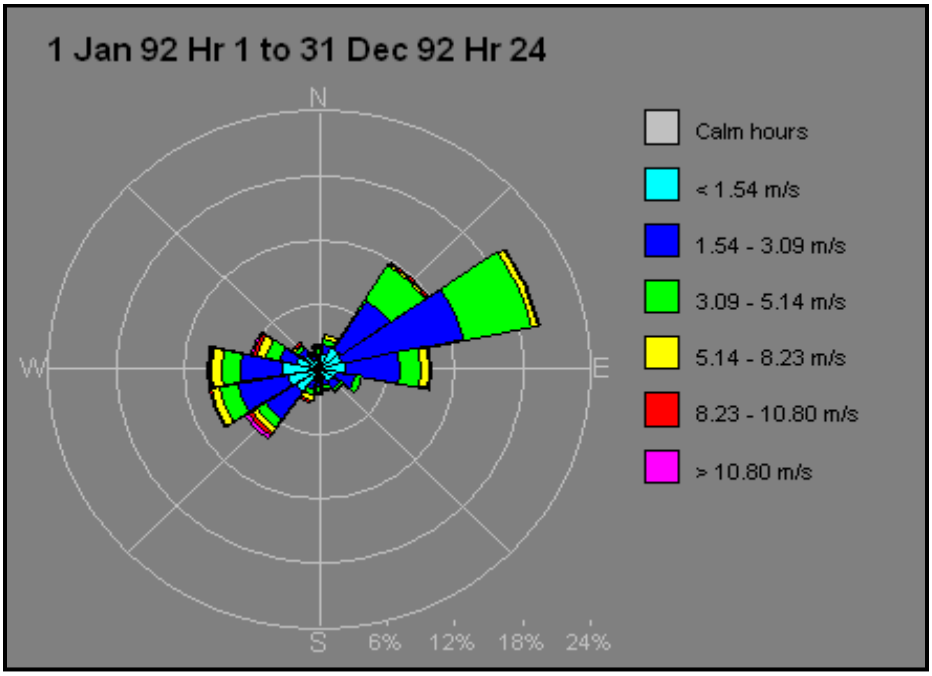


Figure 3-5. Wind Rose for 1992 Data Used in the Near-Field Modeling.

The degree of stability in the atmosphere is also important to the dispersion of emitted pollutants. During stable conditions, vertical movement in the atmosphere is limited and the dispersion of pollutants is inhibited. Temperature inversions can result in very stable conditions with virtually no vertical air motion and light winds, thereby restricting dispersion. Conversely, during convective conditions, upward and downward movement

in the atmosphere prevails along with stronger winds, and the vertical mixing of pollutants in the atmosphere is increased.

3.2.2 Existing Air Quality

3.2.2.1 Criteria Pollutants

NAAQS have been promulgated for the purpose of protecting human health and welfare with an adequate margin of safety. Pollutants for which NAAQS have been set include sulfur dioxide (SO_2), nitrogen dioxide (NO_2), CO, and particulate matter (PM) less than 10 microns in diameter (PM_{10}) and less than 2.5 microns in diameter ($PM_{2.5}$). Existing air quality in the region is acceptable based on the EPA's NAAQS. The surrounding area is designated as an attainment/unclassifiable area, meaning that the concentration of criteria pollutants in the ambient air is less than the NAAQS. Site-specific air quality monitoring data are not available for the Project Area; however, estimated background criteria pollutant concentrations for Duchesne County (see Table 3-3) were provided by the Utah Department of Environmental Quality (UDEQ) Division of Air Quality (DAQ).

Background pollutant concentrations are used as an indicator of existing conditions in the region, and are assumed to include emissions from existing industrial emission sources in operation and from mobile, urban, biogenic, and other non-industrial emission sources. Table 3-4 lists allowable ambient air concentrations for criteria pollutants.

Table 3-3. Background Ambient Air Quality Concentration[1].

Pollutant Averaging Period	Measured Background	Concentration (µg/m3)
Carbon monoxide (CO)	8-hour	1145
	1-hour	1145
Nitrogen dioxide (NO_2) Annual 10	Annual	10
PM_{10}	24-hour	28
	Annual	10
$PM_{2.5}$	24-hour	27.6
	Annual	9.3
Sulfur dioxide (SO_2)	3-hour	20
	24-hour	10
	Annual	5

[1] Background data provided by Utah Department of Environmental Quality Division of Air Quality (DAQ) for Duchesne County. (D. Prey, DAQ, personal communication, 2010.)

Note: Ozone data were not provided by the DAQ because the monitoring network is extremely sparse in this area. The closest ozone data are for the Piceance Basin in Colorado where the measured 1-hour background concentration is 0.88 parts per million (ppm) and the 8-hour background concentration is 0.074 ppm (Colorado Department of Public Health and Environment 2008).
$\mu g/m^3$ = micrograms per cubic meter

Table 3-4. Ambient Air Quality Standards and Class I and Class II PSD Increments

Pollutant/ Averaging Time	NAAQS	CAAQS	UAAQS	PSD Class I Increment[1]	PSD Class II Increment[1]
CO					
1-hour[2]	40,000	40,000	40,000	--[3]	--[3]
8-hour[2]	10,000	10,000	10,000	--	--
NO_2					
1-hour[8]	188				
Annual[4]	100	100	100	2.5	25
O_3					
8-hour[6]	147	147	147	--	--
PM_{10}					
24-hour[2]	150	150	150	8	30
Annual[4]	--[5]	50	50	4	17
$PM_{2.5}$					
24-hour[7]	35	35	35	--[3]	--[3]
Annual[4]	15	15	15	--	--
SO_2					
1-hour[9]	196				
3-hour[2]	1,300	700	1,300	25	512
24-hour[2]	365	365	365	5	91
Annual[4]	80	60	80	2	20

$\mu g/m^3$ = micrograms per cubic meter
PSD = Prevention of Significant Deterioration

1 The PSD demonstrations serve information purposes only and do not constitute a regulatory PSD increment consumption analysis.
2 No more than one exceedence per year.
3 No PSD increments have been established for this pollutant.
4 Annual arithmetic mean.
5 The NAAQS for this averaging time for this pollutant has been revoked by EPA.
6 An area is in compliance with the standard if the fourth-highest daily maximum 8-hour ozone concentrations in a year, averaged over 3 years, is less than or equal to the level of the standard.
7 An area is in compliance with the standard if the 98th percentile of 24-hour PM2.5 concentrations in a year, averaged over 3 years, is less than or equal to the level of the standard.

[8] An area is in compliance with the standard if the 98th percentile of daily maximum 1-hour NO_2 concentrations in a year, averaged over 3 years, is less than or equal to the level of the standard.

[9] An area is in compliance with the standard if the 99th percentile of daily maximum 1-hour SO_2 concentrations in a year, averaged over 3 years, is less than or equal to the level of the standard. Source: (D. Prey, Utah Department of Environmental Quality Division of Air Quality, personal communication, 2008).

Ground-level ozone (O_3) is a secondary pollutant that is formed by a chemical reaction between NO_x and VOCs in the presence of heat and sunlight. Motor vehicle exhaust and industrial emissions, gasoline vapors, some tree species emissions, and chemical solvents are some of the major sources of NO_x and VOCs that help to form ozone. In summer, hot temperatures and intense solar radiation increase emissions of ozone precursors and favor the photochemical reactions that form ozone. As a result, ozone is generally known as a summertime air pollutant. However, recent winter ozone levels have exceeded the 8-hour ozone standard in Sublette County in southwestern Wyoming and indicate that ozone can be a year-round air quality issue. High winter ozone has also been observed in the Uintah Basin. In 2010, the 4th highest daily maximum 8-hour ozone values at the Ouray and Redwash monitors in Uintah County were 117 parts per billion (ppb) and 95 ppb, respectively. High 8-hour average ozone values were observed again during the winter of 2011. The mechanisms for ozone formation under wintertime conditions are not well understood, and this is currently an active area of research. Ozone can be transported great distances and therefore contributes to air pollution issues on a regional scale. Primary health effects from ozone exposure range from breathing difficulty to permanent lung damage. Ground-level ozone also contributes to plant and ecosystem damage (EPA 2009).

Under the PSD provisions of the Clean Air Act (CAA), incremental increases of specific pollutant concentrations are limited above a legally defined baseline level. Many national parks and wilderness areas are designated as PSD Class I. The PSD program protects air quality within Class I areas by allowing only slight incremental increases in pollutant concentrations. Areas of the state not designated as PSD Class I are classified as Class II. For Class II areas, greater incremental increases in ambient pollutant concentrations are allowed as a result of controlled growth. The PSD increments for Class I and Class II areas are presented in Table 3-4.

The location of the project in northeastern Utah required the examination of project and cumulative source impacts in southwest Wyoming, western Colorado, and most of Utah. The analysis area includes the area surrounding the proposed Project Area and all or a portion of the Maroon Bells-Snowmass, West Elk, High Uinta, Holy Cross, Raggeds, Hunter Frying Pan, and Flat Tops Wilderness Areas; the Dinosaur and Colorado National Monuments; the Bryce Canyon, Capitol Reef, Canyonlands, Arches, and Black Canyon of the Gunnison National Parks as well as the Flaming Gorge National Recreation Area and the Brown Park National Wildlife Refuge. The Project Area location and all Class I areas within a 300-kilometer (km) radius are shown in Figure 3-6.

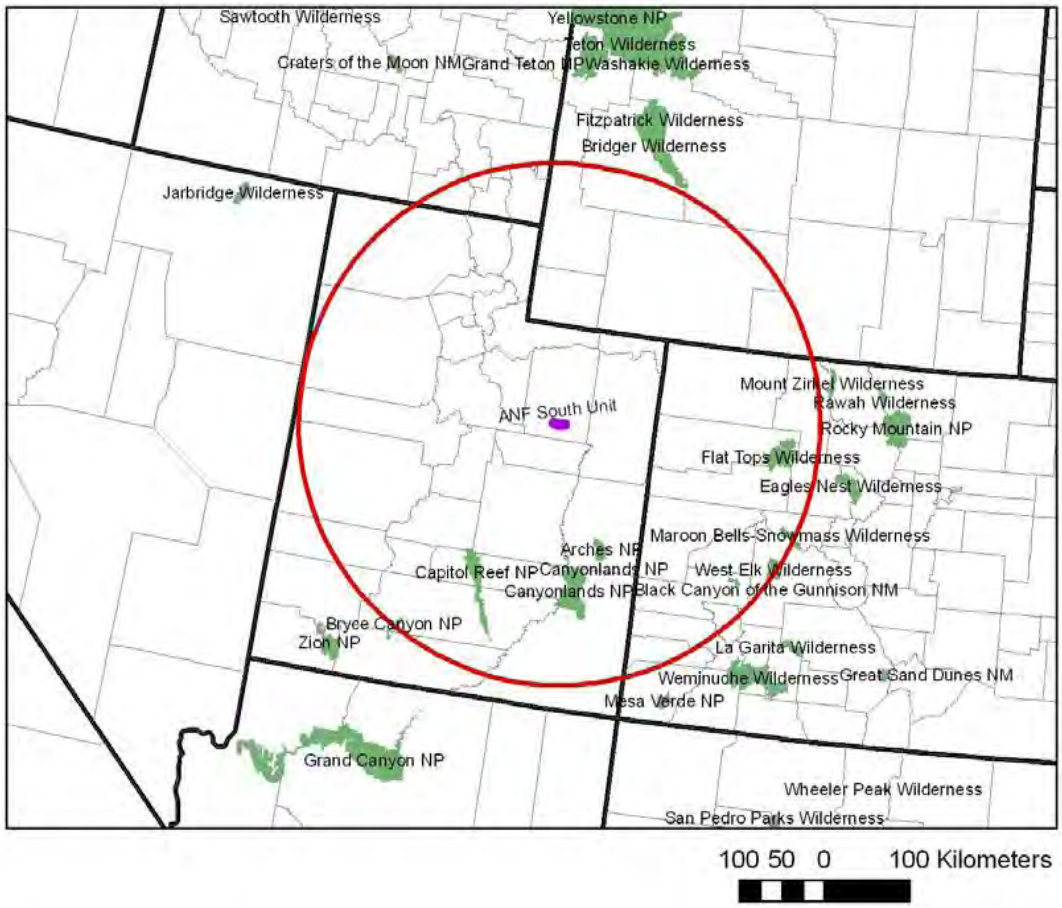


Figure 3-6. Project Location and Class I Areas within 300 Kilometers of Project Area.

3.2.2.2 Hazardous Air Pollutants

Hazardous air pollutants (HAPs) are those pollutants that are known or suspected to cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental impacts. The EPA has classified 187 air pollutants as HAPs. Examples of listed HAPs associated with the oil and gas industry include formaldehyde (HCHO); benzene, toluene, ethylbenzene, isomers of xylene (BTEX) compounds; and normal-hexane (n-hexane).

The CAA requires the EPA to regulate emissions of toxic air pollutants from a published list of industrial sources referred to as "source categories." As required under the CAA, EPA has developed a list of source categories that must meet control technology requirements for these toxic air pollutants. Under Section 112(d) of the CAA, the EPA is required to develop regulations establishing national emission standards for hazardous air pollutants (NESHAP) for all industries that emit one or more of the pollutants in major source quantities. These standards are established to reflect the maximum degree of reduction in HAP emissions through application of maximum achievable control technology (MACT). Source categories for which MACT standards have been implemented include oil and natural gas production and natural gas transmission and storage.

There are no applicable federal or State of Utah ambient air quality standards for assessing potential HAP impacts to human health. Therefore, reference concentrations (RfC) for

chronic inhalation exposure are applied as significance criteria. An RfC is defined by EPA as the daily inhalation concentration at which no long-term adverse health effects are expected. Table 3-5 provides the HAP RfCs. RfCs exist for both non-carcinogenic and carcinogenic effects on human health (EPA 2010). 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 2000). The TSLs are derived from Threshold Limit Values (TLVs) published in the American Conference of Governmental Industrial Hygienists‘ (ACGIH‘s) "Threshold Limit Values for Chemical Substances and Physical Agents" (ACGIH 2007). 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 3-5 lists the corresponding TSLs for each applicable HAP.

Table 3-5. HAP Reference Concentrations and Toxic Screening Levels.

Pollutant	Averaging Time	Non-Carcinogenic RfC [1] (µg/m^3)	TSL (µg/m^3)
Benzene	24-hour		53
Benzene	Annual	30	
Ethylbenzene	24-hour		14,473
Ethylbenzene	Annual	1,000	
Formaldehyde	1-hour		37
Formaldehyde	Annual	9.8	
N-Hexane	24-hour		5,875
N-Hexane	Annual	700	
Toluene	24-hour		6,280
Toluene	Annual	400	
Xylene	24-hour		14,473
Xylene	Annual	5000	

[1] EPA Air Toxics Database, Table 1 (EPA 2010).

µg/m^3 = micrograms per cubic meter

3.2.2.3 Existing Sources of Air Pollution

The Uintah Basin has seen recent oil and gas development on tribal, federal, and private lands. Fugitive dust is the most prominent air pollutant in the region and in the Project Area and is intermittent depending on winds and dust-causing activities. In addition to the Uintah Basin, other geographic areas of industrial and vehicular emissions in the region include the Wasatch Front to the west, the Green River area to the south, and the Castle Valley area to the southwest.

Existing point and area sources of air pollution within the Project Area and surrounding region include the following:

- exhaust emissions, primarily CO, NO_x, $PM_{2.5}$, and formaldehyde, from existing natural gas fired compressor engines used in production of natural gas;
- natural gas dehydrator still-vent emissions of NO_x, CO, BTEX, and n-hexane;

- gasoline and diesel-fueled vehicle tailpipe emissions of VOCs, NO_x, CO, SO_2, PM_{10}, and $PM_{2.5}$;
- SO_x, NO_x, and fugitive dust emissions from coal-fired power plants and coal mining and processing;
- fugitive dust (in the form of PM_{10} and $PM_{2.5}$) from vehicle traffic on unpaved roads, wind erosion in areas of soil disturbance, and road sanding during winter months; and
- long-range transport of pollutants from distant sources contributing to regional haze.

3.2.2.4 Measuring Air Quality

To measure air quality, the ambient concentration of one or more pollutant is measured. Pollutant concentration refers to the mass of pollutant present in a volume amount of air and can be reported in units of micrograms per cubic meter ($\mu g/m^3$), ppm, or ppb. As noted in Table 3-3, the UDEQ DAQ has used monitoring to determine that the region is in compliance with Utah and federal concentration standards shown in Table 3-4. Monitoring protocols, known as reference (or equivalent) methods, must be followed to determine compliance with these standards.

Areas of special concern, including some federally mandated Class I areas and Class II wilderness areas and national parks, are monitored for Air Quality Related Value (AQRV) impacts. These AQRVs include terrestrial and aquatic deposition and visibility impairment. New air quality monitoring specifically designed for the project has not been conducted in or near the Project Area. However, air quality monitoring for the AQRVs has been conducted in the general region using a variety of ambient air quality monitoring systems. The data closest to the Project Area were selected to be reported here as potentially indicative of conditions in and around the Project Area.

3.2.2.5 Atmospheric Deposition

Atmospheric deposition refers to the processes by which air pollutants are removed from the atmosphere and deposited on terrestrial and aquatic ecosystems, and is reported as the mass of material deposited on an area in a period of time (kilograms per hectare per year [kg/ha/yr]). Air pollutants are deposited by wet deposition (i.e., precipitation) and by dry deposition (i.e., gravitational settling of particles and adherence of gaseous pollutants to particles). Total deposition refers to the sum of airborne material transferred to the earth's surface by both wet and dry deposition.

Total terrestrial deposition Forest Service levels of concern (LOCs) have been estimated for several Class I areas, including Canyonlands National Park in Utah (Fox et al. 1989). Estimated total terrestrial deposition LOCs include the "red line" (defined as the total deposition that the area can tolerate) and the "green line" (defined as the acceptable level of total deposition). Total deposition LOCs for Canyonlands include a "red line" set at 10 kg/ha/yr for nitrogen and 20 kg/ha/yr for sulfur, and a "green line" set at 3 to 5 kg/ha/yr for nitrogen and 5 kg/ha/yr for sulfur. The Forest Service acknowledges that these thresholds may not be protective for the most sensitive ecosystems.

The nearest wet and dry deposition measurements collected at a Class I area are available from Canyonlands National Park, located approximately 130 miles south of the Project Area. Wet deposition data for the Canyonlands station are available through the National Atmospheric Deposition Program (NADP) for the period 1997 through 2004. The NADP assesses wet deposition by measuring the chemical composition of precipitation (rain and snow). Similarly, the Clean Air Status and Trends Network (CASTNet) measures the dry

deposition rates of nitrogen and sulfur compounds. Data from the Canyonlands CASTNet station are available from 1995 through 2002.

Tables 3-6 and 3-7 summarize the annual average wet and dry components of total nitrogen and sulfur deposition at Canyonlands. Note that wet deposition data are available from 1997 through 2004, while dry deposition data are available only from 1995 through 2002. The total deposition LOCs for nitrogen and sulfur at Canyonlands are well below the red and the green lines.

The average annual pH of precipitation measured at Canyonlands from 1997 through 2004 was 5.2, and ranged from 5.0 to 5.7 over the period. The natural acidity of precipitation is considered to range from 5.0 to 5.6 pH; therefore, the average pH of precipitation at Canyonlands is at the acidic end of the range.

Table 3-6. Nitrogen Deposition at Canyonlands, Utah.

Chemical Species	Dry Deposition (kg N ha^{-1} yr^{-1})	Wet Deposition (kg N ha^{-1} yr^{-1})	Total Deposition (kg N ha^{-1} yr^{-1})
Ammonium (NH_4^+)	0.1	0.3	0.4
Nitrate (NO_3^-)	0.0	0.5	0.5
Nitric acid (HNO_3)	0.9	-	0.9
TOTAL	1.0	0.8	1.8

kg = kilograms

N = nitrogen

ha = hectare

yr = year

Table 3-7. Sulfur Deposition at Canyonlands, Utah.

Chemical Species	Dry Deposition[1] (kg S ha^{-1} yr^{-1})	Wet Deposition[2] (kg S ha^{-1} yr^{-1})	Total Deposition (kg S ha^{-1} yr^{-1})
Sulfate (SO_4^{2-})	0.1	0.4	0.5
Sulfur dioxide (SO_2)	0.2	-	0.2
Total	**0.3**	**0.4**	**0.7**

kg = kilograms
S = sulfur
ha = hectare
yr = year
[1] Source: Dry deposition collected at Canyonlands CASTNet site (CAN407) from 1995–2002.
[2] Source: Wet deposition data collected at Canyonlands NADP site (UT09) from 1997–2004.
Deposition data represent the annual average over each respective time period.

3.2.2.6 Acid Neutralization Capacity

Aquatic bodies such as lakes and streams are important resources in most Class I areas. Acid deposition resulting from industrial emissions of sulfur- and nitrogen-based compounds can have a toxic effect on the plants and animals of an aquatic ecosystem. Lakes and streams differ in their inherent sensitivity to inputs of acidifying compounds from the atmosphere. For pristine watersheds, the acid neutralization capacity (ANC) is a good indicator of the sensitivity and buffering capacity of the water body to acid

deposition. The ANC for fresh surface waters can be characterized by the combined concentrations of select base positive ions (i.e., calcium, magnesium, potassium, and sodium), expressed in microequivalents per liter (µeq/l) (as in amount of base available to neutralize an equal amount of acid). The lower the ANC, the more sensitive the water body to acidifying compounds and their toxic effects. Table 3-8 summarizes the existing ANC for selected lakes of special concern.

Table 3-8. Potential Acid Neutralizing Capacity Changes at Sensitive Lakes.

National Forest	Lake	Latitude (Degrees)	Longitude (Degrees)	10th Percentile Lowest ANC Value (µeq/l)	Number of Samples	Monitoring Period
Ashley	Bluebell Lake	40.6958	-110.486	56.12	2	1985–2002
Ashley	Dean Lake	40.6786	-110.761	44.71	7	1985-2007
Uinta-Wasatch-Cache	Fish Lake	40.8366	-110.069	96.85	6	2001–2007
Ashley	No Name Lake	40.6708	-110.275	54.94	2	1985-2007
Ashley	Walkup Lake	40.8113	-110.039	54.68	5	2002–2007

µeq/l = microequivalents per liter

Of the lakes listed in Table 3-8, none is considered by the Forest Service to be extremely sensitive to atmospheric deposition since none of the background ANC values is less than 25 µeq/l.

3.2.2.7 Visibility

Visibility is usually characterized by two parameters, visual range (VR) and the light-extinction coefficient (b_{ext}). The VR parameter represents the greatest distance at which a large dark object can be seen, while the b_{ext} represents the attenuation of light per unit distance due to scattering and absorption by gases and particulate matter in the atmosphere. Under typical conditions, the VR and b_{ext} parameters are inversely related to each other. Good visibility conditions are represented by long VRs and low b_{ext} values, while poor visibility conditions are represented by short visual ranges and high b_{ext} values. The dimensions of visual range are length, and the parameter is usually expressed in kilometers (km). The units of b_{ext} are 1/length (inverse length) and the coefficient is typically expressed as "inverse kilometers" (km^{-1}), or "inverse megameters" (Mm^{-1}), the reciprocal of one million meters.

An easily understood visibility index has been developed (Pitchford and Malm 1992) to uniformly describe levels of monitored and modeled visibility impairment and to assess the progress of visibility protection programs. The scale of this visibility index, expressed in deciview (dv), is linear with respect to perceived visual changes over its entire range, analogous to the decibel scale for sound. A one dv change is a small, but usually perceptible scenic change. The dv scale is near zero for a pristine atmosphere and increases as visibility degrades. Because the index increases as haze increases, it is

characterized as a haziness index. A change of any specific number of dv should appear to have approximately the same magnitude of visual change on any scene. The degree to which the deciview scale meets these ideals will depend on the extent to which any scene departs from the assumptions required to develop the scale (Pitchford and Malm 1992). The dv scale provides a convenient, numerical method for presentation of visibility values.

Visibility related background data collected as part of the Interagency Monitoring of Protected Visual Environments (IMPROVE) program are available for Canyonlands National Park (southeastern Utah), Weminuche Wilderness (southwestern Colorado), and White River National Forest (Aspen, Colorado, monitoring site). Long-term (10 years or greater) data are available for Weminuche Wilderness and Canyonlands National Park; however, the available data for White River National Forest are limited to four years.

Figures 3-7 and 3-8 present long-term visibility conditions (as reconstructed from aerosol measurements) for the 20% cleanest, 20% haziest, and mid-range 40% to 60% days at Canyonlands National Park and Weminuche Wilderness (IMPROVE 2006). Both annual average and five-year rolling average visibility data are presented. The annual average data illustrate the variability in visibility conditions that results from forest fires or other short-term factors. The five-year data represent long-term average conditions analogous to the natural visibility conditions tracked under the regional haze program.

Seasonal visibility conditions can be reconstructed using quarterly particle concentrations measured at the IMPROVE monitoring sites in conjunction with monthly relative humidity factors. Figure 3-9 presents the Standard Visual Range for each of the IMPROVE monitoring areas.

As shown, visibility is very good at all three areas with a Standard Visual Range of 193 to 324 km (120 to 201 miles). White River National Forest (Aspen, Colorado, monitoring site) exhibits the best visibility. Seasonal visibility conditions are typically the clearest during the fall and winter months (October through March) when particulate concentrations are at a minimum, while hazier conditions predominate during the spring and summer months (April through September) when particulates are at a maximum.

3.2.2.8 Global Climate

Global climate change is the result of changing atmospheric concentrations of greenhouse gases (GHGs) and aerosols, land-cover, and solar radiation that alter the energy balance of the climate system (Intergovernmental Panel on Climate Change [IPCC] 2007). The rapid increase in GHG emissions (e.g., water vapor, carbon dioxide, methane, nitrous oxides, and chlorofluorocarbons) from human sources has been altering the composition of the earth‘s atmosphere and in turn increased average global temperatures over the past century (CEQ 1997a; IPCC 2007; Energy Information Administration [EIA] 2001). Carbon dioxide is the primary GHG and is largely emitted through the burning of fossil fuels. The level of carbon dioxide in the atmosphere has increased by 30% since the beginning of the Industrial Revolution (CEQ 1997) and by 80% between 1970 and 2004 (IPCC 2007). Additionally, methane levels have doubled and nitrous oxide has increased 15% since pre-industrial times.

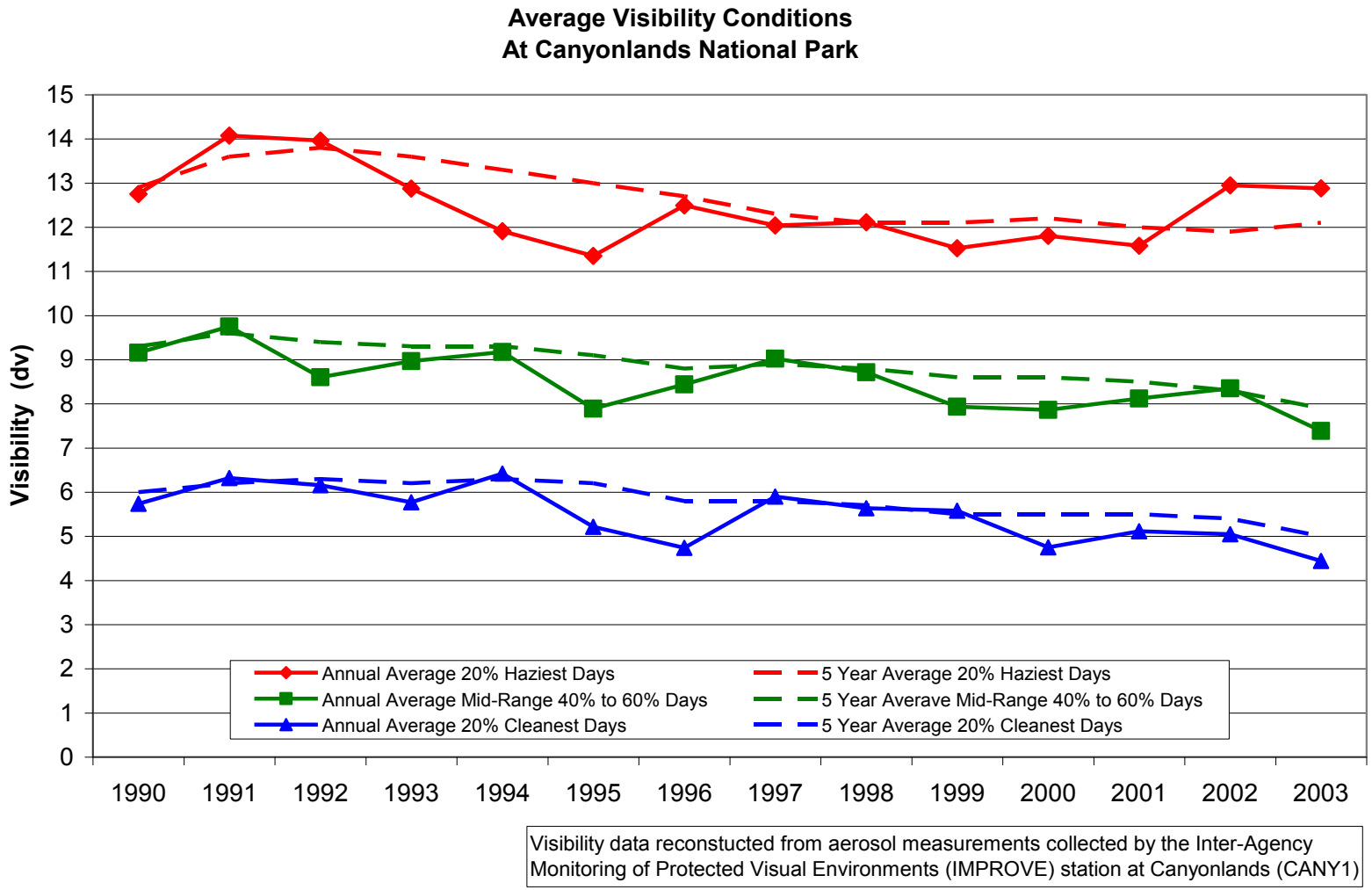


Figure 3-7. Visibility Conditions at Canyonlands National Park, Utah.

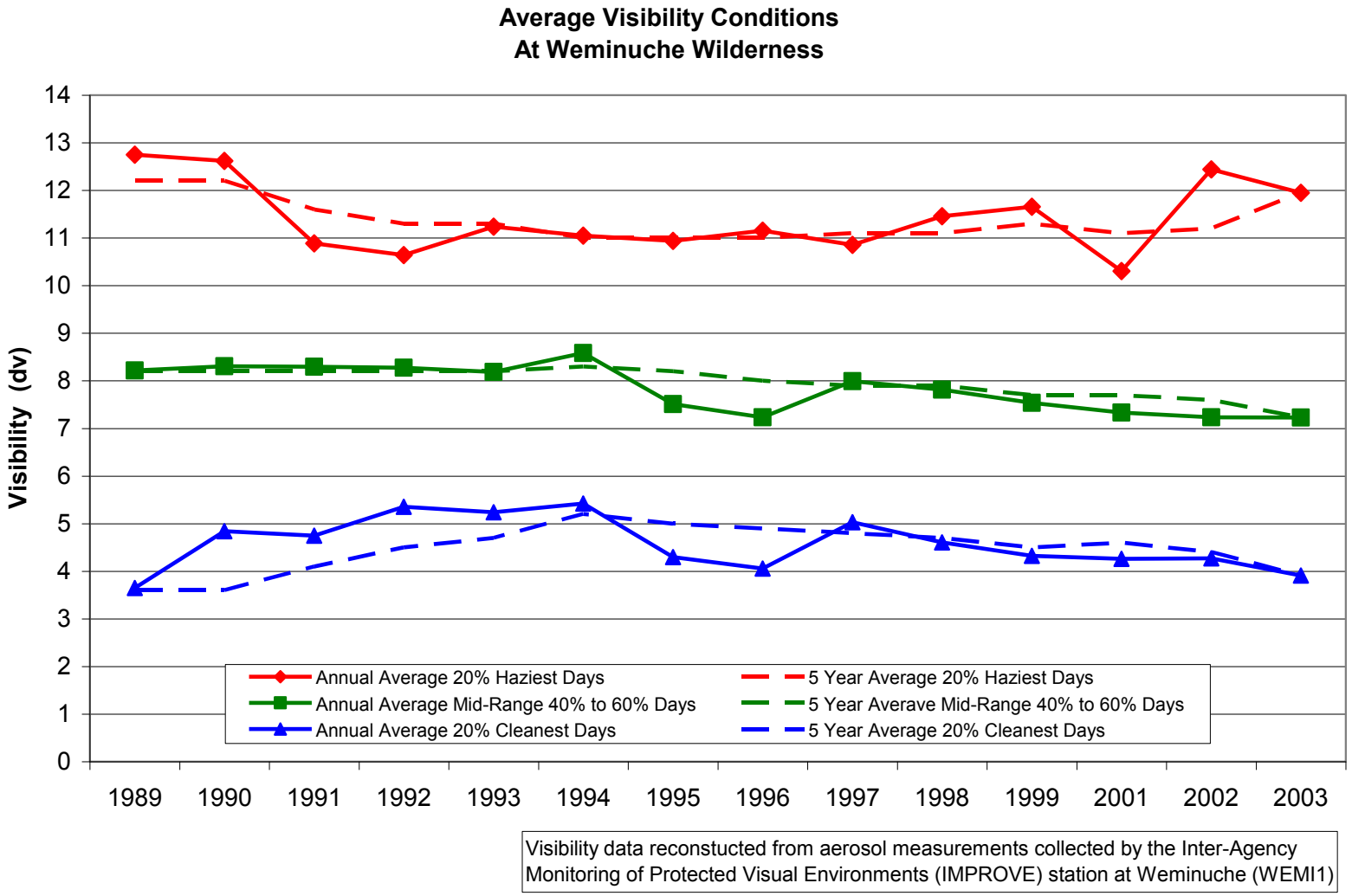


Figure 3-8. Visibility Conditions at Weminuche Wilderness, Colorado.

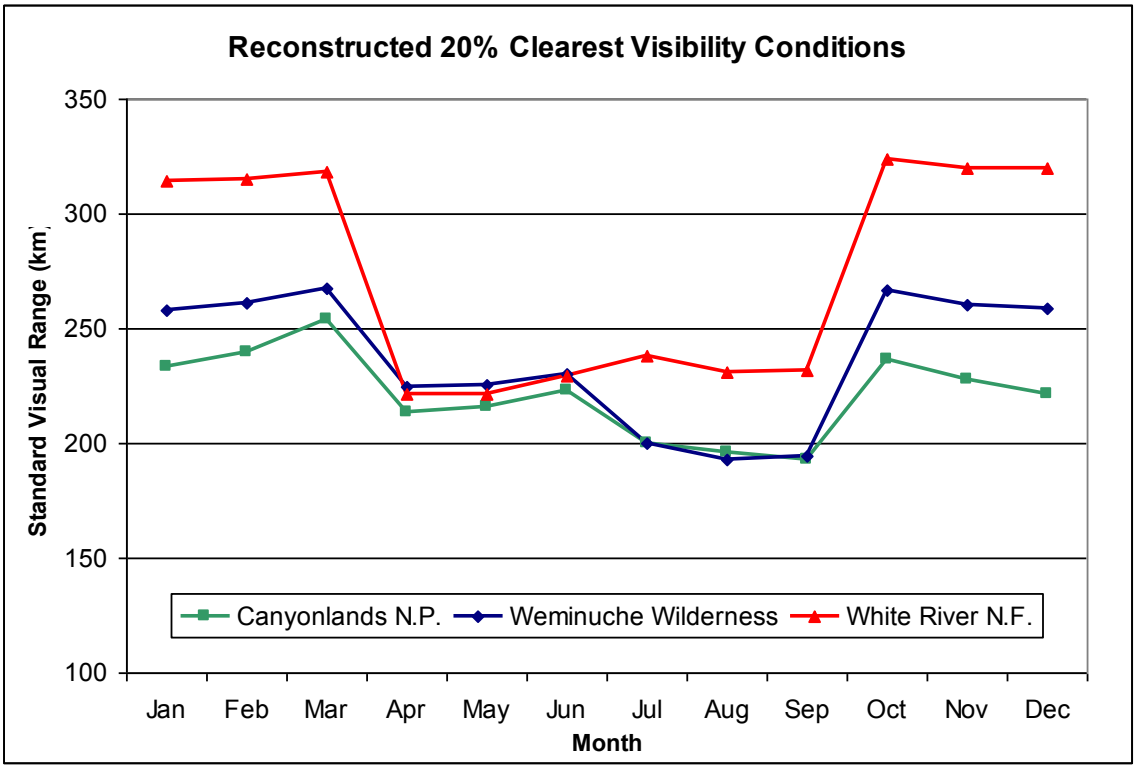


Figure 3-9. Reconstructed 20% Clearest Seasonal Visibility Condition.

In the United States, the average annual growth rate of total GHG emissions was 1.3% from 1990 to 2000 (EIA 2001). During 2000, 81.2% of total U.S. GHG emissions consisted of carbon dioxide from the combustion of fossil fuels such as coal, petroleum, and natural gas (EIA 2001). Activities associated with exploration, development, production, and transportation of natural gas resources result in emissions of GHGs and contribute to global climate change. However, the combustion of natural gas emits almost 30% less carbon dioxide than oil, and approximately 45% less than coal (Naturalgas.org 2008). Some key mitigation technologies and practices available, or soon to be available, in the energy sector include switching fuel from coal to gas, and the storage of removed carbon dioxide from natural gas (IPCC 2007).

3.2.3 Environmental Consequences

3.2.3.1 Introduction

Due to the highly technical nature of air quality modeling and impact analysis, an Air Quality Technical Support Document (AQTSD) has been prepared. This document contains detailed information on the modeling assumptions and results. The following sections are a summary of the information contained in Appendix C.

The location of the project in northeastern Utah required the examination of project and cumulative source impacts in south-central Utah, southwestern Wyoming, and western Colorado within a defined study area (modeling domain) (Figure 1 of Appendix C). The analysis area includes the area surrounding the proposed Project Area and all or a portion of the Maroon Bells-Snowmass, West Elk, High Uinta, Holy Cross, Raggeds, Hunter Frying Pan, and Flat Tops Wilderness Areas; the Dinosaur and Colorado National

Monuments; Bryce Canyon, Capitol Reef, Canyonlands, Arches, and Black Canyon of the Gunnison National Parks; Flaming Gorge National Recreation Area; and the Brown Park National Wildlife Refuge.

Impacts analyzed include those on air quality and AQRVs resulting from air emissions from 1) project sources within the Project Area, 2) non-project state-permitted and RFA sources within the modeling domain, and 3) non-project reasonably foreseeable development (RFD) within the modeling domain. The project source emissions inventory was performed in accordance with the Air Quality Impact Assessment Protocol for the Ashley National Forest South Unit Master Development Plan (ENVIRON 2008).

Modeling analyses were performed to quantify near-field pollutant concentrations within and nearby the Project Area from project-related emissions sources for the most impactful alternative (Proposed Action) to assure that the maximum near-field impacts were estimated. Impacts from both construction and production activities were calculated. Near-field impacts are described in detail in Chapter 3.0 of Appendix C.

Ozone impacts from this project are addressed through a qualitative emissions analysis (see Section 3.2.2.3.5) and also by reference to a recent study of regional ozone impacts of oil and gas development in the Uintah Basin. This analysis, the Uintah Basin Air Quality Study, is also described in Section 3.2.2.3.5. The following tasks were performed for air quality and AQRVs impact assessment.

- Project Air Emissions Inventory: Development of an air pollutant emissions inventory for the project.
- Regional Air Emissions Inventory: Development of an air pollutant emissions inventory for other regional sources not represented by background air quality measurements, including state-permitted sources, RFA, and RFD.
- Project Near-Field Analysis: Assessment of near-field air quality concentration impacts resulting from activities proposed within the Project Area.
- Far-Field Direct Project Impact Analysis: Assessment of far-field air quality concentration and AQRV impacts resulting from proposed project activities.
- Far-Field Cumulative Impact Analysis: Assessment of far-field air quality concentration and AQRV impacts resulting from activities proposed within the Project Area combined with other regional sources inventoried under the second item above.

Details on the methodology and modeling results for these tasks are provided in Appendix C.

3.2.3.2 Direct (Near-field) Impacts

3.2.3.3 Criteria Pollutants

Construction Emissions

Maximum localized PM10/PM2.5, CO, NO2, and SO2 impacts would result from well pad and road construction activities and from wind. The model assumes that 400 wells would be constructed at an even pace of 20 wells per year for 20 years. In order to model a conservative scenario, it was assumed that a central compressor station would be located near a well pad and a mail road would be located in proximity to both. Model receptors were placed at 100-meter intervals beginning 50 meters from the edge of the proposed well pad and road. Flat terrain was assumed for each modeling scenario. Area sources

were used to represent emissions from roads and well pad and compressor construction areas. Industrial Source Complex (ISC) was used to model each scenario 12 times, once at each of 12 30-degree rotations, to ensure that impacts from all directional layout configurations and meteorological conditions were assessed. Wind erosion emissions were modeled for all hours where the wind speed exceeded a threshold velocity defined by emissions calculations performed using AP-42 Section 13.2.5, Industrial Wind Erosion (EPA 2004).

Table 3-9 presents the maximum modeled CO, SO2, NO2, PM10, and PM2.5 concentrations for each well pad scenario. When the maximum modeled concentration was added to representative background concentrations, it was demonstrated that CO, SO2, NO2, and PM10 concentrations for the project comply with and are well below the Ambient Air Quality Standards (AAQA) for Wyoming (WAAQS), Utah (UAAQS), and Colorado (CAAQS), and the NAAQS for criteria pollutants modeled.

Based on new information obtained since the completion of the AQTSD in 2008, the UDEQ DAQ was able to recommend a PM2.5 background value for the Project Area (ENVIRON 2010). The recommended background for 24-hour average 98% value PM2.5 is 27.6 µg/m3 and the annual average PM2.5 value is 9.3 µg/m3. UDEQ DAQ notes that the 24-hour average values of 27.6 µg/m3 is a winter value and that winter values are much higher than non-winter values. These background values were used to model two construction scenarios (Table 3-9). Scenario A is a very conservative construction scenario where there is simultaneous construction of well pads, roads, and compressor stations, and all engines are fully deteriorated. In this scenario, 24-hour PM2.5 is not in compliance with NAAQS. However, Scenario B uses a conservative, but more realistic, construction scenario where roads are built before well pad and compressor station construction begins and engines are approximately 40% deteriorated. In this scenario, the project complies with NAAQS criteria.

Since the completion of the AQTSD in 2008, the EPA has promulgated new NAAQSs for 1-hour NO2 and 1-hour SO2. The model used to evaluate 1-hour NO2 and SO2 was identical to the modeling reported in Appendix C, which did not apply the air quality mitigation measures. Table 3-9 shows the highest 3-year average of the 98th percentile 1-hour NO2 concentrations and the highest 3-year average of the 99th percentile 1-hour SO2 concentrations, as required by the new primary standards.

Table 3-9. Maximum Modeled Construction Concentrations.

Pollutant	Averaging Time	Modeled Value µg/m^3	Background Value µg/m^3	Total Value µg/m^3	UAAQS NAAQS µg/m^3	Compliance
$PM_{2.5}$[1] Scenario A	24-hour	11.82	27.6	39.4	35	N
$PM_{2.5}$ Scenario A	annual	0.151	9.3	9.45	15	Y
$PM_{2.5}$ Scenario B	24-hour	6.57	27.6	34.12	35	Y
$PM_{2.5}$ Scenario B	annual	0.151	9.3	9.45	15	Y
PM_{10}[3]	24-hour	35.06	28	63.06	150	Y
PM_{10}	annual	1.39	10	11.39	50	Y
NO_x	annual	0.36	10	10.36	100	Y

Pollutant	Averaging Time	Modeled Value µg/m³	Background Value µg/m³	Total Value µg/m³	UAAQS NAAQS µg/m³	Compliance
NO_2	1-hour	7.70	75.3	83.1	188	Y
CO[2]	1-hour	458.00	1	459.00	40,000	Y
CO[2]	8-hour	323.63	1	324.63	10,000	Y
SO_2	1-hour	0.6	99	99.6	197	Y
SO_2[2]	3-hour	0.60	20	20.60	1300	Y
SO_2[2]	24-hour	0.16	10	10.16	365	Y
SO_2	annual	0.002	5	5.002	80	Y

[1] 8th high for each year was used to calculate a three-year running average, the maximum three average is reported.
[2] Second highest value was used because the value is not to be exceeded more than once per year.
[3] Fourth highest value for three-year modeling period.
µg/m³ = micrograms per cubic meter
CO = carbon monoxide; NO_x = nitrogen oxide; PM = particulate matter; SO_2 = sulfur dioxide

Production Emissions

Emissions from production activities (well site and compression) would result in the maximum near-field PM10, PM2.5, SO2, NO2, and CO concentrations. Analyses were performed to quantify the maximum impacts that could occur within and nearby the Project Area using the emissions from an in-field compressor station and well emissions. Proposed well emissions include those from artificial lift engines, heaters, flashing, tank losses, truck traffic, and fugitives. Compressor station emissions include those from combustion and dehydration.

Maximum predicted pollutant concentrations are listed in Table 3-10. When these concentrations are combined with representative background concentrations, they are well below the applicable UAAQS, CAAQS, WAAQS, and NAAQS. The production impacts have been evaluated using the new NO2 and SO2 NAAQS promulgated since the completion of the Appendix C (ENVIRON 2010). The model used to evaluate 1-hour NO2 and SO2 was identical to the modeling reported in Appendix C, which did not apply the air quality mitigation measures. Table 3-10 shows the highest 3-year average of the 98th percentile 1-hour NO2 concentrations and the highest 3-year average of the 99th percentile 1-hour SO2 concentrations, as required by the new primary standards.

Table 3-10. Maximum Modeled Production Concentrations.

Pollutant	Averaging Time	Modeled Value µg/m³	Background Value µg/m³	Total Value µg/m³	UAAQS NAAQS µg/m³	Compliance
$PM_{2.5}$[1]	24-hour	6.57	27.6	34.12	35	Y
$PM_{2.5}$	annual	0.151	9.3	9.45	15	Y
PM_{10}[3]	24-hour	19.41	28	47.41	150	Y

Pollutant	Averaging Time	Modeled Value µg/m³	Background Value µg/m³	Total Value µg/m³	UAAQS NAAQS µg/m³	Compliance
PM_{10}	annual	22.68	10	32.68	50	Y
NO_x	annual	7.30	10	17.30	100	Y
NO_2	1-hour	71.7	75.3	147.0	188	Y
CO[2]	1-hour	78.55	1	79.55	40,000	Y
CO[2]	8-hour	45.70	1	46.70	10,000	Y
SO_2	1-hour	0.2	99	99.2	197	Y
SO_2[2]	3-hour	0.13	20	20.13	1300	Y
SO_2[2]	24-hour	0.047	10	10.05	365	Y
SO_2	annual	0.043	5	5.04	80	Y

[1] 8th high for each year was used to calculate a three-year running average; the maximum three average is reported.
[2] Second highest value was used because the value is not to be exceeded more than once per year.
[3] Fourth highest value for three-year modeling period.
µg/m³ = micrograms per cubic meter
CO = carbon monoxide; NO_x = nitrogen oxide; PM = particulate matter; SO_2 = sulfur dioxide

3.2.3.4 Hazardous Air Pollutants

ISC was also used to determine HAP impacts in the immediate vicinity of the Project Area emission sources for short-term (acute) exposure assessment and at greater distances for calculation of long-term risk. Sources of HAPs include well-site fugitive and flashing emissions and compressor station combustion and dehydration emissions. Because maximum field-wide annual emissions of HAPs occur during the production phase, only HAP emissions from production were analyzed.

Short-term HAP concentrations are compared to the TSLs in Table 3-11. The TSLs shown in Table 3-11 were provided by the State of Utah‘s DAQ and define a concentration at or below which no adverse health effects are expected.

Long-term exposures to HAPs emitted by the proposed project were compared to the RfCs. Annual modeled HAP concentrations for all HAPs emitted were compared directly to the non-carcinogenic RfCs and are summarized in Table 3-11. The results of the ISC modeling show that no impacts above any of the RfCs or TSLs are expected to occur as a result of the project.

Estimated cancer risks were evaluated based on the Superfund National Oil and Hazardous Substances Pollution Contingency Plan (EPA 1993), where a cancer risk range of 1x10-6 to 1x10-4 is generally acceptable. Two estimates of cancer risk were evaluated: 1) a most likely exposure (MLE) scenario; and 2) a maximum exposed individual (MEI) scenario. The estimated cancer risks are adjusted to account for duration of exposure and time spent at home.

Table 3-11. Maximum Modeled HAP Concentrations.

Pollutant	Averaging Time	Max Modeled Value µg/m^3	Non-Carcinogenic RfC [1] (µg/m^3)	TSL (µg/m^3)	Compliance
Benzene	24-hour	11.02		53.3	Y
Benzene	Annual	2.20	30		Y
Ethylbenzene	24-hour	0.98		14,466.7	Y
Ethylbenzene	Annual	0.252	1,000		Y
Formaldehyde	1-hour	1.95		37	Y
Formaldehyde	Annual	0.14	9.8		Y
N-Hexane	24-hour	17.54		5,875	Y
N-Hexane	Annual	3.51	200		Y
Toluene	24-hour	13.65		2,512.1	Y
Toluene	Annual	3.40	400		Y
Xylene	24-hour	6.56		14,466.7	Y
Xylene	Annual	1.78	100		Y

[1] EPA Air Toxics Database, Table 1 (EPA 2010).
µg/m^3 = micrograms per cubic meter

The modeled long-term risks from benzene and formaldehyde are shown in Table 3-12. Under the MLE scenario, the estimated cancer risk associated with long-term exposure to benzene and formaldehyde is below $1x10^{-6}$ for all cases. Under the MEI analysis, the incremental risk for formaldehyde is less than $1x10^{-6}$, and both the incremental risk for benzene and the combined incremental risk fall on the lower end of the acceptable cancer risk range of $1x10^{-6}$ to $1x10^{-4}$ mandated by the Superfund National Oil and Hazardous Substances Pollution Contingency Plan (EPA 1993). In summary, the HAP impact analysis shows negligible risk to public health and safety from the proposed project.

3.2.3.5 Cumulative (Far-field) Impacts

Cumulative impact analysis for air quality includes source impacts in south-central Utah, southwestern Wyoming, and western Colorado within a defined study area (modeling domain) (Figure 1 of the Appendix C).

Table 3-12. Long-term Modeled MLE and MEI Cancer Risk Analyses.

Pollutant	Averaging Time	Modeled Value µg/m^3	Unit Risk Value µg/m^3	Exposure Adjustment MLE µg/m^3	Exposure Adjustment MEI µg/m^3	Cancer Risk MLE	Cancer Risk MEI
Benzene	Annual	2.20	7.8E-06	0.0949	0.86	1.63E-6	1.48E-5
Formaldehyde	Annual	0.14	1.3E-05	0.0949	0.86	1.73E-7	1.56E-6

[1] MLE = most likely exposure; MEI = maximum exposed individual.

[2] EPA Air Toxics Database, Table 1 (EPA 2005).

$\mu g/m^3$ = micrograms per cubic meter

Criteria Pollutants

The maximum predicted concentrations of NO_2, SO_2, PM_{10}, and $PM_{2.5}$ at any receptor within the PSD Class I areas for the project are shown in the Appendix C, Table 6. The proposed project's contribution to these concentrations at any Class I area are highest at the Arches National Park in Utah (Arches). These project contributions are less than 1% of the PSD Class I area increments. The largest impact is for 24-hour PM_{10} where the project values are estimated at approximately 0.8% of the PSD Class I area increment at Arches. The far-field results demonstrate that the maximum air quality impacts for the project would be unlikely to exceed any PSD Class I increment at any Class I area.

The Appendix C, Table 20 displays the maximum estimated PSD pollutant concentrations at Class I areas due to the project plus the cumulative emissions inventory and compares them to the PSD Class I increments. The maximum CALPUFF-estimated impacts due to the project plus the cumulative sources always occur at the Flat Tops, Arches, Capitol Reef, Canyonlands, and Maroon Bells-Snowmass Class I areas. These impacts are:

- less than 2% of the PSD Class I increments for annual, 24-hour, and 3-hour SO_2 concentrations;
- less than 2% and 5% of the PSD Class I area increments for annual and 24-hour PM_{10}, respectively; and
- less than 9% of the PSD Class I area increment for annual NO_2.

The estimated air quality impacts due to the project plus the cumulative emissions would not exceed any PSD Class I area increment at any Class I area. The CALPUFF-estimated maximum concentration due to the project and the cumulative emissions at any Class I area were combined with the existing maximum background concentrations (Appendix C, Table 15) in the region to obtain a total estimated concentration that is compared against the NAAQS, WAAQS, UAAQS, and CAAQS (Appendix C, Table 23). When the project plus the cumulative potential impacts at any Class I area are added to the maximum background concentrations to obtain a total concentration, no federal or state ambient air quality standards are exceeded. In summary, the modeling results indicate that neither direct project impacts nor cumulative source impacts would exceed any air quality standard (WAAQS, UAAQS, CAAQS, and NAAQS) or PSD Class I area increments. The PSD demonstrations are for informational purposes only and do not constitute a regulatory PSD increment consumption analysis.

Sulfur and Nitrogen Deposition

CALPUFF modeling results for the project alone indicate that all direct project total nitrogen (N) or sulfur (S) deposition impacts are well below the Forest Service LOC (5.0 kg ha^{-1} yr^{-1} for S, 3.0 kg ha^{-1} yr^{-1} for N) and the USDA Forest Service Deposition Analysis Thresholds (DATs; 0.005 kg ha^{-1} yr^{-1}) at any Class I area (Appendix C, Table 28). For the project plus the cumulative emissions, the estimated N and S deposition are also well below the Forest Service LOC (Appendix C, Table 29). The S deposition is below the DAT, but the N deposition is above the DAT for the Flat Tops, Maroon Bells-Snowmass, West Elk, Black Canyon of the Gunnison, and Arches Class I areas. The maximum estimated annual N at any Class I area for the project plus cumulative emissions occurs at the Flat Tops Class I area with values of approximately 0.05 kg ha^{-1} yr^{-1} estimated for all

three modeled years. These maximum N deposition impacts are approximately a factor of 100 lower than the Forest Service 3.0 kg ha^{-1} yr^{-1} LOC.

Acid Neutralizing Capacity Calculations for Sensitive Lakes

The results of the ANC calculations performed for the project plus cumulative emissions are presented in Appendix C, Table 34. There are five sensitive lakes in the study area; all have background ANC greater than 25 μeq/l and therefore are not classified as extremely sensitive. For these five lakes, for which a change in ANC above 10% is a concern, the maximum changes in ANC are estimated to range from 0.09% to 0.25%. The deposition impacts from direct project and cumulative emissions would not contribute significantly to an increase in acidification at any of the five sensitive lakes. Thus, the project plus the cumulative emissions (including RFD sources) are estimated to have no significant impact on lake acidity at any lake in the region.

Visibility

The BLM considers a 1.0 change in deciview (dv) (10% change in extinction) to be a significant impact. Using the visibility methods 2 and 6 (defined in Appendix C) and the 1.0 change in dv threshold, modeling indicated that the proposed project would not cause a 1.0 change in dv threshold and therefore would not have a detrimental impact at any Class 1 Area (Appendix C, Table 35).

Ozone

Unlike other atmospheric pollutants, ozone is not primarily emitted into the atmosphere. Ozone is produced in the atmosphere as a result of combining precursor pollutants with solar radiation.

These precursor pollutants can reside in the atmosphere for significant amounts of time and travel over significant distances. As a result, ozone impacts are best assessed on a regional scale, accounting for the precursor pollutant emissions from all available sources within a reasonable distance. Such an analysis should account for the emission and modeled transport of ozone and its precursors as well as the modeled atmospheric chemistry that would result from their interaction. The CALPUFF air pollution dispersion model does not include adequate atmospheric chemistry to simulate the complete reactions that lead to the formation of ozone. Modeling the impacts to ozone concentrations is relevant in a larger regional context including all significant sources of NOx and VOCs. To complete a modeling analysis of this complexity was found to be beyond the economic limitations of this EIS project. Modeling impacts to ozone concentrations from this project are not recommended because the project‘s contributions are unlikely to be noticeable in the model compared to cumulative contributions. In other words, the modeling results would not likely provide useful or meaningful information to a decision maker because ozone models typically are not precise enough to accurately convey the contribution from small contributors of NOx and VOCs. However, it is understood that because the formation of ozone depends on the ratio of NOx to VOC, it follows then that, in general, a reduction in these ozone precursors would result in a reduction in ozone levels.

Qualitative Analysis

Since the completion of the AQTSD in 2008, concern has grown regarding ozone air quality issues in the Uinta Basin. The Forest Service and the EPA discussed ozone analysis for this EIS on June 5, 2009. The agencies agreed that quantitative ozone

modeling is not appropriate for this project due to the mitigation measures agreed to by the Operator. Rather than perform ozone modeling for the proposed project, the EPA and the Forest Service are recommending the Operator to implement the emissions reduction measures described in Section 2.2.5 and listed in Table 3-13 below. Implementation of these measures would result in emissions reductions, which, in turn, would result in an overall reduction in ozone impacts. Thus, the agencies agreed that a reasonable approach is to provide a qualitative ozone analysis for this EIS combined with ozone monitoring, and emission mitigation to minimize ozone impacts. The emissions reductions were computed by applying the measures to the Proposed Action emission inventory that was developed for the near-field and far-field modeling and is described in detail in the Appendix C.

Based on the analysis (ENVIRON 2010), the largest reduction in NOx emissions would come through the installation of pump jack engines that meet applicable NSPS (Table 3-13). This measure would also greatly reduce VOC and HAP emissions from pump jack engines. Since the CO emissions factor supplied by the Operator during the original emission inventory already met the NSPS CO requirement, this measure would not result in additional reductions in CO emissions. Installation of controls on compressor engines would result in an estimated 57% reduction in NOx emissions and a 71% reduction in CO emissions compared to the original inventory. Controls placed on condensate tank batteries and dehydrators at the compressor stations would reduce emissions of VOCs and HAPs by 95%. Operators intend to install three-phase separators at two of the four compressor stations which would result in a reduction in VOC emissions of about 9% and HAPs reductions of 20 to 30%.

Table 3-14 shows the percent reduction in emissions resulting from the mitigation measures during various stages of the project. See Table A46 in Appendix C for the emissions levels before mitigation. This again shows that installation of pump jack engines that meet applicable NSPS would greatly reduce NOx, VOC, and HAPs emissions.

Table 3-15 shows the effects of the mitigation measures taken at compressor stations. The various controls on the compressor engines bring the NOx emissions down to 12 tons per year (tpy) from 28 tpy (a 57% reduction) and CO reduced from 30 tpy to 9 tpy (a 71% reduction). VOC emissions also decrease by approximately 56 tpy (84%).

Changes in the project-wide emissions for the peak emissions year, which is the final year of the project, are shown in Table 3-16 in terms of both absolute magnitude and percent reduction. Mitigation measures would decrease NOx emissions by 70%, going from 611 tpy to 189 tpy. VOC emissions decrease 11% from 3212 tpy to 2862 tpy and CO decrease 17% from 512 tpy to 428 tpy. Formaldehyde (HCHO) emissions decrease 23% from 22 tpy to 17 tpy. The mitigation measures, therefore, result in a substantial decrease in ozone precursors and formaldehyde, which also plays a role in ozone formation through production of radicals.

Table 3-13. Emissions Mitigation Measures and Corresponding Emissions Reductions Given as a Percentage of Original Emissions.

	Percent Emissions Reduction											
Operator Committed Mitigation Measure	**NOx**	**SO_2**	**CO**	**VOCs**	**HCHO**	**Benzene**	**Toluene**	**Ethyl-benzene**	**Xylene**	**N-Hexane**	**CO_2**	**CH_4**
Install pump jack engines that meet NSPS limits.	85	0	0	99	71	71	71	71	71	0	0	71
Install secondary control systems on compressor engines.	57	0	71	0	0	0	0	0	0	0	0	0
Install emission controls on condensate tank batteries and dehydrators with control efficiencies of ≥95%.	0	0	0	95	0	95	95	95	95	95	0	95
Install three phase separators at compressor stations to reduce flashing emissions.	0	0	0	8.8	0	29	30	29	26	23	0	0.16
Use drill rigs that meet EPA Tier II standards or better.	This measure was incorporated into the original emissions inventory. No emissions reduction.											
Implement a leak detection program consistent with EPA Method 21.	No emissions reduction.											
Install/operate an ozone monitoring station.	No emissions reduction.											
Route pneumatic pump emissions to emission control devices, or back into process stream.	Pneumatic pumps were not included in the original emissions inventory, so emissions reductions cannot be calculated.											
Conduct green completions when venting wells.	Venting was not included in the original emissions inventory, so emissions reductions cannot be calculated.											
Test flaring controls annually to ensure they meet >90% efficiency.	Flaring was not included in the original emissions inventory, so emissions reductions cannot be calculated.											
Install viton/teflon seals on hatches and valves.	Inventory not detailed enough to provide quantitative reduction for tank load out and fugitives. Complete mitigation of all fugitives from valves would result in a reduction of 0.2 ton/well VOC, 0.6 ton/well CH_4, and negligible reduction in HAPs.											
Ensure VOC collection systems are adequate for LOP.	No quantifiable emissions reduction.											
Install low/no bleed pneumatic controllers and valves.	Pneumatic devices were not included in the original emissions inventory, so emissions reductions cannot be calculated.											
Consolidate production facilities for multiple wells on individual pads.	No quantifiable emissions reduction.											
Recycle/reuse approximately 70% of produced water.	No emissions expected from produced water.											

Table 3-14. Percent Reduction of Emissions at Well Sites due to Mitigation Measures by Category.

Category	Percent Reduction of Emissions per Well																			
	NOx	SO_2	CO	VOCs	PM_{10}	$PM_{2.5}$	PM filt	PM cond	PMC	PMF	EC	SOA	HCHO	Benzene	Toluene	Ethyl-Benzene	Xylene	N-Hexane	CO_2	CH_4
Pad Construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Well/Pipe Const. Fugitive Dust	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pad Construction Traffic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wind Erosion	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pipeline Construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Drilling	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Drilling Traffic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Completion	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Completion Traffic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Install Prod Eq Traffic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tank W/B Losses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heaters	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Artificial Lift Engines	85.5	0	0	99.34	0	0	0	0	0	0	0	0	71.04	71.04	71.04	71.04	71.04	0	0	71.04
Flashing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fugitives	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Production Traffic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tank Load out	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Construction	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Total Production	**76.73**	**0**	**0**	**4.19**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**70.74**	**3.15**	**0.08**	**0.04**	**0.04**	**0**	**0**	**7.36**
Total Peak Year Well Emissions	**71.73**	**0**	**0**	**4.18**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**70.74**	**3.15**	**0.08**	**0.04**	**0.04**	**0**	**0**	**7.36**

Table 3-15. Effects of Mitigation Measures on Compressor Station Emissions.

Mitigation Measures	Production Emissions per Compressor Station (tons/year)																			
	NOx	SO_2	CO	VOCs	PM_{10}	$PM_{2.5}$	PM filt	PM cond	PMC	PMF	EC	SOA	HCHO	Benzene	Toluene	Ethyl-Benzene	Xylene	N-Hexane	CO_2	CH_4
Without Mitigation	28.24	0.00	29.73	66.72	0.66	0.66	0.01	0.65	0.00	0.00	0.01	0.65	3.80	1.20	0.88	0.03	0.35	1.81	7227.06	90.95
With controls on dehydrators & condensate tanks; secondary control on engines	12.08	0.00	8.63	11.21	0.66	0.66	0.01	0.65	0.00	0.00	0.01	0.65	3.80	0.06	0.04	0.00	0.02	0.09	7227.00	82.57
% Reduction	**57.22**	**0.00**	**70.97**	**83.19**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**95.00**	**95.00**	**94.20**	**95.00**	**95.00**	**0.00**	**9.22**
With controls on dehydrators & condensate tanks; secondary control on engines; three phase separators	12.08	0.00	8.63	10.22	0.66	0.66	0.01	0.65	0.00	0.00	0.01	0.65	3.80	0.04	0.03	0.00	0.01	0.07	7227.00	82.43
% Reduction	**57.22**	**0.00**	**70.97**	**84.68**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**96.47**	**96.51**	**95.89**	**96.32**	**96.17**	**0.00**	**9.37**

Table 3-16. Total Project Emissions during the Peak Emissions Year.

Mitigation Measures	Total Emissions in Peak Emissions Year (tons/year)																			
	NOx	SO_2	CO	VOCs	PM_{10}	$PM_{2.5}$	PM filt	PM cond	PMC	PMF	EC	SOA	HCHO	Benzene	Toluene	Ethyl-Benzene	Xylene	N-Hexane	CO_2	CH_4
Without mitigation	611	1	512	3212	453	58	5	10	395	44	5	10	22	17	185	16	109	53	118503	1134
With mitigation measures except three phase separators	189	1	428	2866	453	58	5	10	395	44	5	10	17	12	182	16	107	47	118503	1043
% Reduction	**69.05**	**0.00**	**16.48**	**10.75**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**22.57**	**28.80**	**1.88**	**0.84**	**1.26**	**12.88**	**0.00**	**7.95**
With mitigation measures including three phase separators	189	1	428	2862	453	58	5	10	395	44	5	10	17	12	182	16	107	46	118503	1043
% Reduction	**69.05**	**0.00**	**16.48**	**10.87**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**22.57**	**29.21**	**1.91**	**0.86**	**1.28**	**13.04**	**0.00**	**8.00**

3.2.4 Cumulative Analysis

The Forest Service has developed a cumulative ozone analysis based on the best currently available "scientifically credible" evidence. The analysis, which was based on existing regional modeling simulations, also describes the relative completeness of the information available as well as the potential shortcomings of the available modeling data. To ensure that the requisite "hard look" was completed under NEPA, the analysis was completed in keeping with 40 CFR Section 1502.22 which reads:

When an agency is evaluating reasonably foreseeable significant adverse effects on the human environment in an environmental impact statement and there is incomplete or unavailable information, the agency shall always make clear that such information is lacking. (b) If the information relevant to reasonably foreseeable significant adverse impacts cannot be obtained because the overall costs of obtaining it are exorbitant or the means to obtain it are not known, the agency shall include within the environmental impact statement:

1. a statement that such information is incomplete or unavailable;
2. a statement of the relevance of the incomplete or unavailable information to evaluating reasonably foreseeable significant adverse impacts on the human environment;
3. a summary of existing credible scientific evidence which is relevant to evaluating the reasonably foreseeable significant adverse impacts on the human environment, and
4. the agency's evaluation of such impacts based upon theoretical approaches or research methods generally accepted in the scientific community.

Given that a novel photochemical modeling analysis could not be reasonably completed for a cost that would not be considered exorbitant, the Forest Service acknowledges that the assessments of ozone impacts on both a direct and cumulative level are potentially incomplete. With ambient ozone data indicating that regional ozone has been increasing throughout the state of Utah, particularly in regions with oil and gas development, the issue of ozone impacts is important to the determination of overall adverse impacts associated with this EIS.

As a result, the Forest Service has undertaken an assessment of existing scientifically credible evidence that would be able to bound the potential regional impacts associated with ozone concentrations. Given that potential future ozone impacts are best predicted by the use of a photochemical modeling analysis, the initial assessment focused on the availability of such modeling analyses. The assessment concluded that the most recent, peer-reviewed, photochemical modeling analysis which included the Project Area within its modeled domain was the Uinta Basin Air Quality Study (UBAQS). As a result, this modeling simulation was selected for use in assessing total ozone impacts for this EIS leasing project.

The UBAQS, funded by the Independent Petroleum Association of the Mountain States (IPAMS), was initiated in 2008 and was completed in June 2009 (IPAMS 2009). The study sought to assess the regional air quality impacts of oil and gas production on the Uinta Basin in Utah, and includes the cumulative contributions of this project and other projects in the region. The UBAQS is an independent technical analysis that is currently separate from any agency authorization or actions analyzed under the NEPA.

UBAQS sought to assess the cumulative change in air quality from the regional expansion of oil and gas resources. In order to develop this assessment, primary and precursor emissions were developed for two modeled scenarios. These scenarios, occurring in model year 2005–2006 and 2012, included recorded (for 2005–2006) and reasonably foreseeable (for 2012) emissions from all sources that resided or would reside within the model domain. Proposed oil and gas related sources for both modeled scenarios were sourced from regional and sub-regional emissions assessments. They utilized best available information to determine spatially representative oil and gas emissions. These emissions were then extrapolated forward in time to account for growth of oil and gas production throughout the domain for the 2012 scenario. Air quality modeling in the UBAQS was performed using the Community Multiscale Air Quality (CMAQ) (Byun and Ching 1999) modeling system to estimate changes in ozone, air quality, and AQRVs due to existing and projected future emissions sources, including oil and gas development located within the Uintah Basin.

EPA recommends using the model in a relative sense to scale current observed 8-hour ozone Design Values. In order to perform this scaling operation EPA developed the Modeled Attainment Test Software (MATS) tool that uses modeling results (observed 8-hour ozone Design Values) to project 8-hour ozone concentrations that reflect the change in emissions from a base case to an alternative emissions scenario. For the UBAQS, the MATS tool was used to assess the effects of oil and gas development activities as well as regional emissions in the modeling domain on 8-hour ozone. The MATS tool performs 8-hour ozone Design Value projections at existing monitoring sites for comparison with the 8-hour ozone NAAQS. Additionally, the MATS tool has a capability to perform an Unmonitored Area Analysis that performs a spatial interpolation of the current year observed 8-hour ozone Design Values using the ozone concentration gradients calculated from the gridded model base year outputs.

Although the UBAQS represents the best currently available peer-reviewed photochemical modeling simulation which includes the EIS project region, it should be noted that the UBAQS does have potential shortcomings that are recognized by the Forest Service. To ensure that all available information is provided with regard to the existing scientific evidence available for review, the following items should be noted in regards to the use of the UBAQS.

1. There is not sufficient air monitoring data in the UBAQS modeling study, because at the time the study was performed, this data was not available for the area.
2. The UBAQS primary modeling domain was subdivided into 12-km grid squares, instead of the preferred 4-km grids, for a large portion of central and eastern Utah and western Colorado. The accuracy of modeled predictions from a 12-km or greater grid spacing for areas of complex terrain has tended to be suspect.

3. The modeling domain was subdivided into 12-km grid squares to provide additional detail on the locations of existing oil and gas emission sources. It is not clear how hypothetical emissions from the ANF oil and gas leasing scenarios were reflected in the UBAQS study.
4. The UBAQS future modeled predictions for year 2012 are not particularly useful for project development activities occurring beyond the year 2012.

Given that the UBAQS does contain shortcomings, the Forest Service feels that its use is appropriate only in the limited NEPA disclosure context inherent in CEQ's guidance on incomplete information. A summary of the results of this study are presented below. Many aspects of the proposed UBAQS followed procedures similar to a NEPA-related far-field air quality assessment. However, the UBAQS differs from a NEPA-related analysis in one important aspect; rather than focusing on one particular project and its related potential air quality impacts, the UBAQS serves as a planning tool for the BLM to better manage oil and gas development on federal lands in the Uintah Basin as a whole. Therefore, the results of this study should not be used to estimate potential ozone impacts of this project in relation to impacts of all other sources in the Uintah Basin regional emission inventory.

The maximum CMAQ estimated annual NOx emissions would be well below (33% of the allowable NAAQS) the applicable NAAQS standard. However, compared against 2005 and 2006 inventories, NOx emissions from oil and gas sources are projected to increase by 18% between 2006 and 2012. The primary sources of NOx emissions in 2012 are anticipated to be drilling rigs and permitted and unpermitted compressor engines. These facilities are projected to account for approximately 67% of total basin-wide NOx emissions, which are projected to reach 16,547 tons per year in the Uintah Basin. The primary source of VOC emissions is anticipated to be from glycol dehydrators and flashing emissions from condensate and oil tanks. These facilities are projected to account for approximately 57% of total VOC emissions in the Uintah Basin in 2012, which are projected to reach approximately 127,495 tons per year in the Uintah Basin. The projected 2012 oil and gas emissions of criteria pollutants (including VOC emissions) by county for the Uintah Basin can be found in Table OV-2 in the UBAQS. Cumulative NOx emissions are provided in Table 3-17 and can also be found in Appendix C.

Table 3-17. Cumulative NOx Emissions in tons per year for the States of Utah, Colorado, and Wyoming.

Source	NOx Emissions
State of Utah	11,934.75
State of Colorado	8,061.01
State of Wyoming	1,813.80
RFD Sources	13,150.20
State Permitted Wells; CO, WY, UT	3,095.40
Grand Total	**38,055.16**

The UBAQS modeling study provides a quantitative estimate of future year ozone impacts of projected oil and gas development within the Uintah Basin. Two types of ozone results were presented: 1) estimates of ozone concentrations at areas where monitors have been installed, and 2) estimates where no monitors have been installed, such as rural areas. Eleven of the 33 monitoring sites have current year observed design values that exceed the

current 8-hour ozone NAAQS. The same 11 monitors are projected to continue to exceed the 8-hour ozone NAAQS in 2012, while the remaining 22 monitoring sites would remain below NAAQS in 2012. In areas without monitoring stations, the CMAQ model estimated that the Uintah Basin would be in attainment of the 8-hour ozone NAAQS for 2012. The EPA design value methodology predicted that air quality monitors that currently show NAAQS ozone violations would continue to do so. Year 2012 design values in rural areas would achieve the 8-hour ozone NAAQS except for an area at the border of Duchesne and Summit counties and three grid cells in Emery County.

It is anticipated that comprehensive ozone studies by the Federal Leadership Forum (FLF) and the Western Regional Air Partnership's (WRAP) West Jump Air Quality Modeling Study (AQMS) will provide information to assess wintertime ozone at some future date. Global Climate

The assessment of GHG emissions and climate change is an ongoing scientific endeavor. According to the U.S. Geological Survey (USGS) (2008), ―It is currently beyond the scope of existing science to identify a specific source of CO2 emissions and designate it as the cause of specific climate impacts…" Oil and gas development may contribute to emissions of GHGs; however, the amount of any contribution cannot be compared to any regulatory standards because there are no applicable federal or state standards at this time. Given these limitations, accounting and disclosure of potential GHG emissions is the preferred option at this time. A comparison between project emissions and total Utah, Colorado, Wyoming, and United States emissions is provided in Table 3-18. Sources of CO2 from the project include emissions from construction activities, operations, and maintenance.

Table 3-18. Modeled GHG Emissions.

Source	CO_2 Equivalent (metric tons/year)	Project Contribution
Proposed Action[1]	1.06E+05	100%
United States (2006)	7.08E+09	0.001%
Utah (2005)	6.88E+07	0.154%
Colorado (2005)	1.18E+08	0.090%
Wyoming (2005)	5.60E+07	0.189%

[1] Year of maximum emissions

Sources: EIA 2006; UDEQ 2006

The EPA has evaluated the likely cumulative impacts from increased atmospheric CO2 levels for the Mountain West (EPA 2008). This analysis indicates that climate change is projected to lead to ―significant changes in the Mountain West and the Great Plains." EPA has also evaluated a variety of potential national and global impacts from climate change (EPA 2007). These impacts include an increased average temperature, shrinking of glaciers, thawing of permafrost, later freezing and earlier and earlier break-up of ice on rivers and lakes, lengthening of growing seasons, shifts in plant and animal ranges, and earlier flowering of trees. Human health, agriculture, natural ecosystems, coastal areas, and heating and cooling requirements are examples of systems that are sensitive to climate change.

The IPCC has developed emission scenarios that, in the absence of additional emissions mitigation, project an increase of global GHG emissions by 25% to 90% between 2000 and 2030 (IPCC 2007). Continued GHG emissions at or above current rates would cause further global surface warming through the twenty-first century. According to the results of climate modeling based on emission scenarios, a warming of about 0.2 degree Centigrade per decade is projected for a range for the next two decades.

In their ongoing assessments, the IPCC concludes that climate change could adversely impact human health and environment, including impacts to drinking water, agricultural productivity, and infectious diseases (CEQ 1997a; IPCC 2001, 2007). The projected impacts from climate change for North America during the twenty-first century include decreased snowpack and more winter flooding in the western mountains. Decreased snow would also reduce summer flows and increase competition for allocated water resources. Moderate climate change in the early part of the century could increase yields of rain-fed agriculture by 5% to 20%, but this would vary among regions. Climate change could negatively affect crops that are near the warm end of their suitable range or which depend on highly utilized water resources. It is projected that the number, intensity, and duration of heat waves in cities will increase, with potential for adverse health impacts. Coastal communities and habitats will be stressed by climate change impacts interacting with development and pollution (IPCC 2007).

3.3 Geology and Minerals

3.3.1 Affected Environment

3.3.1.1 Topography and Physiography

The Project Area is located in the Uintah Basin, a structural and topographic basin that encompasses more than 9,300 square miles, in Duchesne and Uintah counties, Utah. The Uintah Basin and the northerly adjacent Uinta Mountains comprise the northern Colorado Plateau physiographic unit. The anticlinal Uinta Mountains form a distinct topographic unit parallel to the Utah/Wyoming state border. The Uintah Basin is bounded to the north by the east/west-trending Uinta Mountains, and by the Book Cliffs, Roan Cliffs, and Badlands Cliffs of the Tavaputs Plateau to the south. The basin is bordered to the west by the eastern faulted margin of the Wasatch Mountain Uplift and to the southwest by the San Rafael Swell. To the east, the Uintah Basin is separated from the Piceance Basin by the Douglas Creek Arch, located near the Colorado/Utah state border.

The Uintah Basin is an asymmetric synclinal basin, with a steeply dipping northern flank and a more gradual rise to the south. Topography in the Project Area is dominated by buttes, mesas, and deep canyons. Major drainages flow southwest to northeast and include from west to east Sowers, Wire Fence, Brundage, Nutters, and Antelope canyons. Elevations in the Uintah Basin vary from approximately 5,000 feet to over 11,000 feet above sea level. The Project Area is located in the southwestern part of the basin where elevations range from approximately 6,400 to 9,100 feet above sea level.

3.3.1.2 Regional Geologic Setting

Sediments that comprise the Uinta Mountains were first deposited in an east/west-trending basin between 1,000 and 600 million years ago (Ma). During that time, over 25,000 feet of shallow-water sandstone and shale accumulated from westward-flowing stream deposits (Rasmussen et al. 1999). The basin filled and major deposition was halted, although slight

periodic subsidence allowed for thickening of sedimentary deposits (Stokes 1986). These deposits were eventually uplifted during the Rocky Mountain-forming Laramide orogeny to form the Uinta Mountains. In conjunction with the uplift, the southerly adjacent synclinal Uintah Basin formed (Rasmussen et al. 1999).

The anticlinal structure of the Uinta Mountains is broken by subsidence in eastern Utah, creating the depression for the flow of the Green River. The Green River is currently cutting away the bench surfaces that characterize the Marginal Benches Subsection. These old erosion surfaces surround the higher regions, especially in the Eastern Subsection, and are covered with core gravel remnants (Stokes 1986).

During Eocene time (50–38 Ma), large amounts of sediment from adjacent higher areas were deposited in lacustrine and fluvial environments in the Uintah Basin. These sediments, which make up what are now characterized as the Colton, Wasatch, Green River, and Uinta formations, are perhaps more than 15,000 feet thick in the center of the basin (Bureau of Indian Affairs [BIA] 2007). During the Paleocene and Eocene, the Uintah Basin was dominated by ancestral lakes, notably Lake Uinta and Lake Flagstaff. The southern shore of Lake Uinta was generally very broad and flat, which allowed water levels to rise and fall in response to climatic and tectonic-induced changes, creating large transgressive and regressive shifts in the shoreline. This cycle of fluctuating water levels deposited sediment in the southwest Uintah Basin and resulted in numerous stacked deltaic deposits. The development of the Colton (Wasatch) and Green River formations, which contain much of the basin‘s oil and gas fields, is closely tied to the lacustrine cycles (Morgan et al. 2003).

Structurally, the uppermost Cretaceous and lowermost Tertiary stratigraphic units within the Uintah Basin dip towards the trough of the basin at an angle of 4 to 6 degrees while the younger Eocene and earliest Oligocene units dip less steeply (Dubiel 2003). No major faults are present within the Project Area; however, the Uintah Basin boundary fault occurs to the north, and a series of three major north/south-trending faults occur to the southwest within the Wasatch Plateau, related to the an eastward extension of Basin and Range-style tectonics (Dubiel 2003). The Project Area is immediately underlain by three bedrock units and one superficial deposit (Witkind 1995). These geologic units include, from oldest to youngest, the Saline facies of the Green River Formation, the Sandstone-limestone facies of the Green River Formation, the Lower member (Wagonhound Member) of the Uinta Formation, and Holocene-age alluvium. The sedimentology and stratigraphy of the surface geologic units within the Project Area are discussed in greater detail in the Paleontological Resources section. The sedimentology, stratigraphy, and economic potential of the subsurface target units are discussed in the following sections.

3.3.1.3 Reservoir Geology

Exposures of the early to middle Eocene-age Green River Formation are present throughout a large geographic area encompassing northeastern Utah, northwestern Colorado, and southwestern Wyoming. The transition from dominantly fluvial to dominantly lacustrine depositional environments in the greater Green River Basin generally began in the late early Eocene and this lacustrine environment is preserved in rocks of the Green River Formation. The formation was deposited in a vast lake system that covered most of northwestern Colorado, southwestern Wyoming, and northeastern Utah (Bryant et al. 1989), although Lake Gosiute to the north and Lake Uinta to the south actually may never have been physically connected.

In the Uintah Basin, the Green River Formation conformably overlies and intertongues with the fluvial Wasatch, Colton, and North Horn formations and Flagstaff Limestone and is conformably overlain by and intertongues with the Duchesne River and Uinta formations (Hail 1992; Dubiel 2003). These geologic units in turn conformably and unconformably overlie the Mesaverde System; including the Cretaceous-age Price River Mesaverde formations, the Castlegate Sandstone, the Blackhawk Formation, and the Emery Sandstone Member of the Mancos Shale (see Figure 3-10).

The Green River Formation is lithologically characterized by thin, even, continuous beds of marlstone, oil shale, siltstone, and tuff deposited in deeper waters, and massive shallow water-deposited sandstone and oolitic, algal, and ostracodal limestone beds that are not laterally continuous (Bradley 1931; Cashion 1967, 1973; Cashion and Donnell 1974; Dane 1954; Duncan et al. 1974; Roehler 1993). The Green River Formation is subdivided into four members which are, from oldest to youngest, the Lower, Middle, Upper, and Saline Members. Bryant (1990) also records a fifth member known as the Sandstone and Limestone Facies. The Upper Member, Saline Facies, and Sandstone and Limestone Facies are exposed on the surface while the primary productive reservoirs in the Project Area are the Lower and Middle Members. These units are illustrated in Figure 3-10, which illustrates the bedrock geology within the Project Area. The base of the Mahogany oil shale defines the top of the Middle Member of the Green River Formation (MGR). The top of the carbonate marker bed defines the boundary of the Middle and Lower members (Morgan et al. 2003).

Morgan et al. (2003) subdivided the Middle and Lower members of the Green River Formation into a series of regionally correlable log cycles. The Middle Member contained 18 identifiable cycles, with a total thickness averaging 1,900 feet, plus the carbonate marker unit (i.e., the boundary between the Lower and Middle members). The top of the uppermost cycle, MGR 18, correlates to the middle marker of Ryder et al. (1976). Five cycles (principal reservoirs) were identified in the Lower Member of the Green River Formation (LGR), consisting of one or more beds with unique depositional history, petrology, and diagenesis. In stratigraphically ascending order the reservoirs are Uteland Butte, Castle Peak, lower Douglas Creek, upper Douglas Creek, and Garden Gulch (Engler and Cather 2007) (Figure 3-11). The reservoir in the Uteland Butte interval is mainly lacustrine limestone with rare bar sandstone beds, whereas the reservoirs in the overlying four intervals are mainly distributary channel and shallow lacustrine sandstone beds (Engler and Cather 2007). The average thickness of the interval from MGR 18 to the top of the Castle Peak is about 1,900 feet, the Castle Peak interval averages about 475 feet, and the uppermost Uteland Butte (LGR 5-3) averages about 120 feet total (Engler and Cather 2007).

3.3.1.4 Economic Geology Resource Potential

The Uintah Basin contains a rich reserve of hydrocarbon resources. The USGS (2003) estimated undiscovered resources at a mean of 21 trillion cubic feet of gas (TCFG), a mean of 60 million barrels of oil, and a mean of 43 million barrels of natural gas liquids within the Uintah and Piceance basins. These reserves have been quantified by geologic unit, identified as five ―Total Petroleum Systems," nearly all of which contain continuous (unconventional) rather than conventional gas resources. In terms of potential oil production, the Green River Total Petroleum System contains the bulk of producing zones, with the combined conventional and continuous sources equaling over 85% (mean

of 48.41 million barrels of oil) of the total available (USGS 2003). As of 1994, production of almost 365 million barrels of oil (MBO) occurred from the Green River system (Dubiel 2003). Gas reserves are less significant in the Green River Total Petroleum System: 13 TCFG is estimated to be in the Mesaverde Total Petroleum System, seven TCFG is in the Mancos/Mowry Total Petroleum System, and the remaining one TCFG is in the Phosphoria and Green River Total Petroleum Systems (USGS 2003).

Existing fields in the greater Monument Butte area (Duchesne, Brundage, Sowers, Antelope Creek, Uteland Butte fields, and Monument Butte area) produce from southern deltaic shoreline deposits, as preserved in the Middle and Lower members of the Green River Formation. The notably productive Brundage Canyon field is located immediately north of the Project Area.

Engler and Cather (2007) completed a Project Area-specific analysis of the resource potential development and concluded that the highest potential development is in the northern Project Area with decreasing potential to the south. The Castle Peak unit is the main reservoir with production dependent on the amount and distribution of sandstone porosity and the presence of natural fractures. In another classification system, the Project Area falls into the Uinta Green River Conventional Oil and Gas Assessment Unit (AU), AU 50200501, a normally pressured system less than 8,500 feet deep (Dubiel 2003). The western and northern marginal-lacustrine environments of the Green River Formation, a description generally matching the Project Area, have the highest potential for undiscovered fields within this unit (Dubiel 2003).

While the Green River Formation is the primary drilling target, other reservoirs are also potential producers including reservoir rocks of the Mesaverde Group, the Mesaverde Group, the Dakota Sandstone, the Cedar Mountain and Morrison formations, and the Entrada Sandstone (Dubiel 2003; BIA 2007).

The Uinta Formation has rarely been a primary drilling target, but it is a shallow, low-cost target that may have potential for new discoveries (BIA 2007). Most of the production that has occurred in the Uinta Formation is from the Lower Uinta, which is a transitional unit between the Green River Formation and the fluvial Upper Uinta (BIA 2007). Engler and Cather (2007) reported several recent successful completions in the Wasatch (Colton) Formation just to the northwest of the Project Area. The Wasatch (Colton) is in a favorable structurally high position within the Project Area itself. The Mesaverde Formation and Mancos Shale, although higher risk, has also become targets in the Uintah Basin, but maximizing production requires technological innovations, such as resource characterization and improved well completions (Engler and Cather 2007).

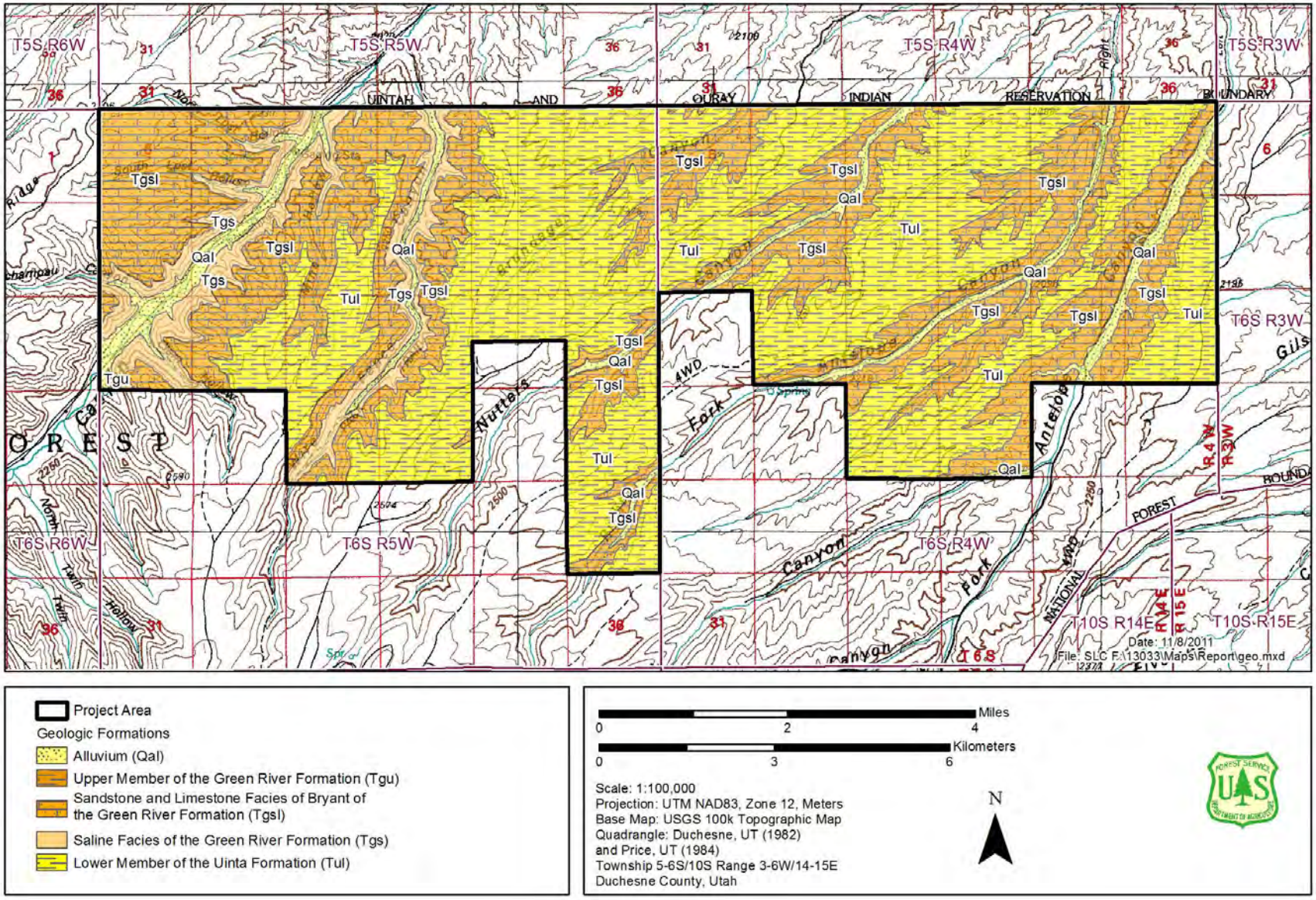


Figure 3-10. Bedrock Geology in the Project Area.

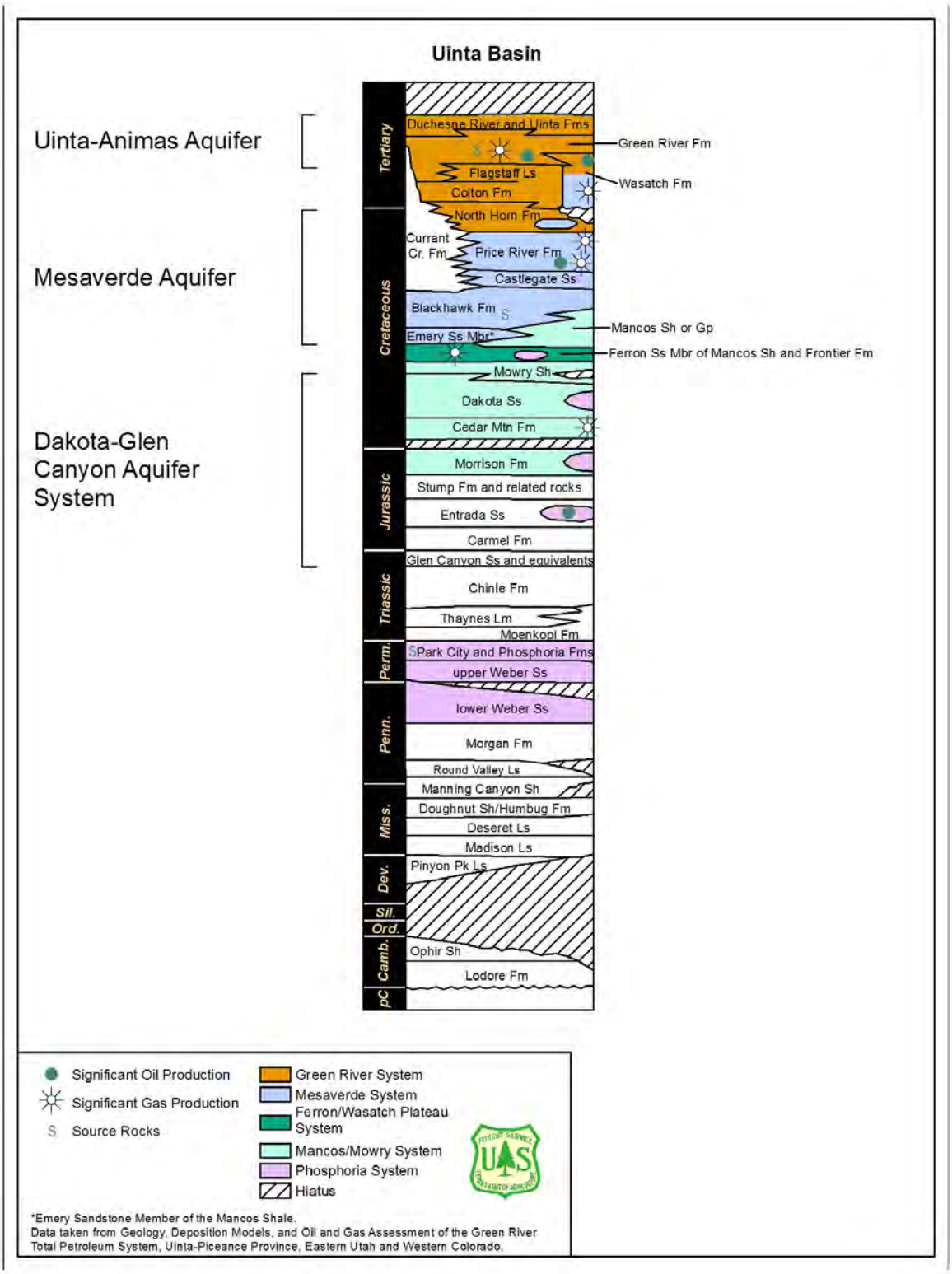


Figure 3-11. Uinta Basin Stratigraphic Column.

3.3.2 Environmental Consequences

Project impacts to topography would be proportional to the magnitude of surface disturbance. Potential impacts to the topographic character of the project would result from construction of oil- and gas-related infrastructure including well pads, pits, and access roads. Visible impacts would be greatest during the drilling and completion phases of the project. The extent of impact on topography depends on the number of well pads, the number of directionally drilled wells, slope restrictions of well pad locations, and magnitude of post-construction erosion. Design elements and mitigation measures described in Chapter 2, both interim and after project completion, would minimize impacts below a significant level.

The primary potential direct impact to mineral resources would be the depletion of recoverable oil and natural gas reserves from the Green River Formation. Active oil and gas development would be designed to efficiently drain and maximize mineral resource recovery. This irreversible commitment of resources would be economically beneficial to the general public during the LOP. However, all extracted resources would no longer be available for future energy needs. Possible oil and gas resources within the underlying Wasatch, Mesaverde, and Dakota formations would remain. Direct impacts to oil and natural gas resources are directly correlated to the amount of extraction which, in turn, depends on the number and spacing of wells and their level of successful production.

3.3.2.1 Impacts Common to All Alternatives

Topography

Several design elements and mitigation measures incorporated into alternatives would affect topography. First, erosion-control design elements installed during and immediately after construction would minimize erosion that would otherwise enlarge the area disturbed. Second, reduction of well pad size after completion would involve the reshaping and stabilization of cut and fill slopes, again reducing erosion that could lead to a greater topographic impact. Thirdly, at the end of the production phase, well pads would be recontoured to resemble the adjacent natural topography. Thus, visible impacts would be greatest during the drilling and completion phases of the project but would then be reduced at the end of the project.

Slope instability potentially leads to mass wasting, which is a function of slope and geological substrate. The potential for occurrence of mass wasting is increased with the removal of stabilizing vegetation, the addition of construction loads, vibrations from construction activities, and structural support changes from cut-an-fill volumes. Effects of the action alternatives are anticipated to result in increased rates of mass wasting, which include landslides, slumps, flows, soil creeps, and rock falls. Mass wasting susceptibility in the Project Area ranges from very low to moderate as determined by the underlying bedrock geology and frequent occurrence of steep slopes (>25%) (Giraud and Shaw 2007). Additional details describing potential impacts to slope stability in the Project Area are provided in the Soil, Water, and Geological Resources Specialist Report (available in the project record). The expected degree and frequency of impacts to slope stability will be analyzed on a site-specific basis through the APD process and further micrositing and site-specific geotechnical analysis.

Economic Geology Resource Potential

All proposed oil and gas wells would be drilled to an average depth of approximately 6,000 feet for all alternatives. Thus, all impacts to oil and gas resources would occur in the

Green River Formation. A potentially greater impact to the mineral resource would occur in the northern half of the Project Area due to a higher well density (40-acre spacing).

The impacts discussed assume full development of each alternative design. However, the actual impact may be less as a result of actual spacing and geographic distribution of wells, and from wells proposed but not drilled over the LOP. The Proposed Action assumes that these drilling program factors would be based on actual discoveries of economic quantities of oil and gas resources.

3.3.2.2 Direct and Indirect Impacts by Alternative

While the type of direct and indirect impacts is common to all alternatives, the extent of their occurrence varies by alternative and is discussed below.

Alternative 1 – No Action Alternative

Topography

Under the No Action Alternative, no new well bores would be drilled. Authorizations for and impacts from previously approved oil and natural gas exploration and surface disturbance would continue within the project area. The remaining oil and gas resources would remain in formation. Alternative 1 would have the least impact on the topography of all the resources.

Economic Geology Resource Potential

Under the No Action Alternative, no new well bores would be drilled. Thus, extraction of oil and gas would continue only from the existing wells within the Project Area. Alternative 1 would have the least impact on the economic geology resource potential of all the alternatives.

Alternative 2 – Proposed Action

Topography

New short-term surface disturbance would be approximately 1,361 acres. Total long-term disturbance associated with project development is estimated to be approximately 595 acres after reclamation. Alternative 2 would have the greatest impact on topography of all the alternatives.

Economic Geology Resource Potential

The Proposed Action assumes conventional (i.e., vertical) drilling of 400 wells, the maximum development scenario. Thus, full depletion of the oil and/or gas resources within the target formation is expected (Engler and Cather 2007). Alternatives 2, 3, and 4 are expected to have the same amount of impact on oil and gas resources in the Green River Formation.

Alternative 3

Topography

Alternative 3 contains a stipulation limiting well locations on slopes greater than 25%. This restriction would reduce but not eliminate the affect of development on topography by eliminating well pads with the largest cuts and topographic changes. Under this alternative, directional drilling would be allowed and thus may reduce the overall number of well pads and resulting disturbed area and would reduce the impacts to topography. The conceptual layout of this alternative (Figure 2-3) shows the elimination of two well pads.

The reduction of impacts to topography under this alternative would be correlated to the actual number of well pads eliminated.

New short-term surface disturbance would be approximately 1,355 acres. Total long-term disturbance associated with project development is estimated to be approximately 590 acres after reclamation. Alternative 3 would have approximately the same impact on topography as the Proposed Action if directional drilling is not used.

Economic Geology Resource Potential

Alternative 3 would allow directional drilling and could result in the construction of fewer well pads. However, downhole well spacing would remain consistent with the other alternatives to drill up to 400 wells using a combination of new and existing well pads. Directional drilling is expected to be as successful as conventional drilling (Engler and Cather 2007). Thus, full depletion of the oil and/or gas resources within the target formation is expected. Alternatives 2, 3, and 4 are expected to have the same amount of impact on the oil and gas resources in the Green River Formation.

Alternative 4

Topography

Under Alternative 4, the number of well pads would not exceed 162 resulting in approximately 39% less short-term surface disturbance and 26% less long-term disturbance compared to Alternatives 2 or 3. New short-term surface disturbance would be approximately 836 acres. Total long-term disturbance associated with project development is estimated to be approximately 411 acres after interim reclamation. Thus, depending on the existing topography of well pad locations, which is not known at the programmatic level, Alternative 4 most likely would have the second least impact on topography.

Economic Geology Resource Potential

While the number of well pads and surface disturbance is limited in Alternative 4, the maximum number of wells allowed would remain consistent with the other alternatives (up to 400 well wells using a combination of new and existing well pads.). Directional drilling would be used to accomplish this extraction and is expected to be as successful as conventional drilling (Engler and Cather 2007). Thus, full depletion of the oil and gas resources within the target formation is expected. Alternatives 2, 3, and 4 are expected to have the same amount of impact on the oil and gas resources in the Green River Formation.

Cumulative Impacts

The Proposed Action and all action alternatives, combined with other oil and gas drilling currently ongoing and proposed for the region, would further deplete oil and natural gas resources from the Green River Formation. It is reasonably foreseeable that some of the project wells might also target other deeper oil and gas-bearing formations beneath the project area. If so, this would likely deplete oil and natural gas from other deeper geologic formations beneath the project area.

3.3.3 Mitigation

Mitigation measures and design elements included in the action alternatives in Chapter 2 are intended to mitigate impacts to topography over the LOP.

3.4 Paleontology

3.4.1 Affected Environment

Paleontological resources, or fossils, are the remains, imprints, or traces of once-living organisms preserved in rocks and sediments. These include mineralized, partially mineralized, or unmineralized bones and teeth, soft tissues, shells, wood, leaf impressions, footprints, burrows, and microscopic remains. Fossils are considered non-renewable resources because the organisms they represent no longer exist. Thus, a fossil can never be replaced once destroyed.

The Project Area includes three bedrock units and one surficial deposit (Witkind 1995). These geologic units include, from oldest to youngest, the Saline facies of the Green River Formation, the Sandstone-limestone facies of the Green River Formation, the Lower member (Wagonhound Member) of the Uinta Formation, and Holocene-age alluvium. In Sowers and Wire Fence canyons, the saline facies is exposed on the lower canyon sides, with the sandstone-limestone facies exposed on the upper canyon walls, while the Uinta Formation forms the ridge tops. To the east, in Brundage, Nutters, and Antelope canyons, only the stratigraphically higher rocks are present, with the sandstone-limestone facies forming the lower canyon sides and the Uinta Formation forming the upper canyon slope and ridge tops. Alluvium is present in the canyon bottoms throughout the Project Area.

The geology and paleontology of each potentially affected geologic unit within the Project Area is discussed in the following sections and summarized in Table 3-19. This analysis is based on a literature review and a records search of the Utah Geological Survey paleontological database and Brigham Young University fossil locality files. Each geologic unit is ranked according to the Probable Fossil Yield Classification (PFYC) system (Forest Service 1996b). The PFYC system uses the close relationship between paleontological resource occurrences and the geologic units in which they are preserved. The PFYC designations for the affected geologic units used in this analysis were assigned by the BLM Regional Paleontologist or the ANF Geologist, as specified. Figure 3-12 illustrates the paleontological sensitivities in the Project Area using the PFYC system.

3.4.1.1 Alluvium

Holocene-age alluvium is composed primarily of poorly consolidated silt, sand, and cobbles derived from eroded bedrock and older alluvial and colluvial deposits. These sediments are deposited by rivers and streams in stream channels and on active alluvial floodplains. Deposits are a wide range of thicknesses, usually less than 50 feet thick. This unit is designated PFYC Class 2 by the BLM.

3.4.1.2 Uinta Formation

In the Uintah Basin, the Uinta Formation consists of greenish-gray, reddish-brown, yellow, grayish-orange, and purple fluvial and lacustrine shale marlstone, siltstone, and sandstone beds that are locally tuffaceous (Cashion 1973; Dane 1954; Rowley et al. 1985). In general terms, the Uinta Formation conformably overlies and interfingers with the Green River Formation and is overlain by the Duchesne River Formation. Like the underlying Green River Formation, the Uinta Formation represents a complex, heterogeneous depositional environment on a basin-wide scale.

In the western part of the basin, the Uinta Formation interfingers with the sandstone-limestone facies of the Green River Formation (Bryant et al. 1989). Previous

paleontologists (Bradley 1931; Dane 1954) assigned the lacustrine rocks of the sandstone-limestone facies to the predominantly alluvial Uinta Formation. Limestone beds are increasingly common in the Uintah Basin from the central to western parts of the basin, representing high stands of Lake Uinta (Bryant et al. 1989). The upper unit of the Uinta Formation in the Salt Lake City Quadrangle (western basin) differs from that to the east by the increased amount of gray clay and paludal limestone beds (Bryant et al. 1989). North of Duchesne, the Uinta Formation mudstones interfinger with the sandstones of the Duchesne River Formation.

Table 3-19. Paleontological Sensitivities of Geologic Units within the Project Area.

Geologic Unit	Map Symbol	Age	Typical Fossils	PFYC
Alluvium	Qa	Holocene	May contain scattered and typically poorly preserved fossil remains of mammoth, bison, deer, and small mammals or other animals	Class 2
Uinta Formation, Lower member	Tul	Eocene	Locally abundant plants (leaves, seeds, wood); invertebrates (insects, mollusks); and a highly diverse and scientifically important vertebrate fauna (reptiles, mammals)	Class 5
Green River Formation, sandstone-limestone facies	Tgsl	Eocene	Locally common plant and invertebrate fossils (mollusks and insects), less common vertebrate fossils (fish, reptiles)	Class 4
Green River Formation, saline facies	Tgs	Eocene	Uncommon plant and invertebrate fossils (mollusks and insects)	Class 3
Green River Formation, Upper member	Tgu	Eocene	Ichnofossils (insect, bird, and mammal tracks); invertebrates (insects and mollusks); plants (leaves and wood); vertebrates (fish and less common reptiles and mammals)	Class 4

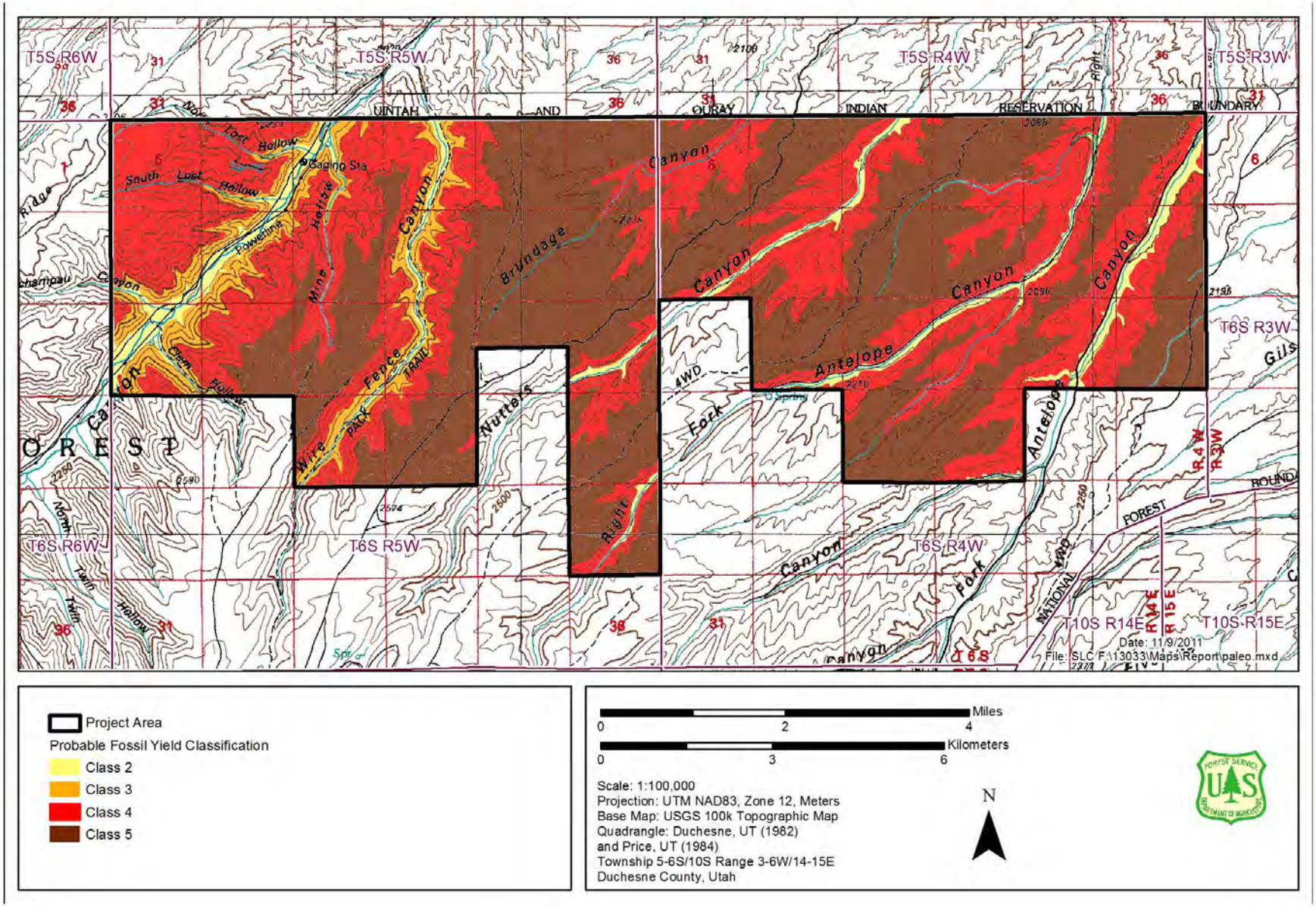


Figure 3-12. Paleontological Sensitivity Distribution within the Project Area.

The Uinta Formation is scientifically important because it is the stratotype for the Uintan North American Land Mammal Age (NALMA) and represents nearly all of Uintan time (46.5–40.0 Ma) (Murphey and Evanoff 2007; Townsend 2004; Walsh 1996). Approximately 31% of modern mammalian families appear in the fossil record of North America during the Uintan NALMA (Black and Dawson 1966). Many of the new taxa are thought to have either originated in North America or emigrated from Asia (Beard 1998; Black and Dawson 1966; Stucky 1992). The distinctive shift in the composition and diversity of mammalian communities that occurred during the Uintan is marked by the disappearance or decline of more archaic groups such as condylarths, some types of insectivores and marsupials, plesiadapoids, and oxyaenid creodonts. At the same time, more modern groups including lagomorphs, selenodont artiodactyls, advanced carnivorans, and non-ischyromyine rodents began to dominate mammalian communities. Refer to Rasmussen et al. (1999), Townsend (2004), and Walsh (1996) for further discussions of the mammalian faunas and biostratigraphy of the Uinta Formation. The lower member of the Uinta Formation is designated PFYC Class 5 by the BLM.

3.4.1.3 Green River Formation

Locally abundant fossil concentrations in the Green River Formation are present throughout its geographic area. For more than 100 years, the Green River Formation has been the primary source of Eocene-age freshwater fishes in North America (Grande 1984) and thus is most well known for this fossil type. Other common fossil types include ichnofossils (Moussa 1968); an abundant and diverse flora (MacGinitie 1969); a large assemblage of arthropods including insects (Coddington 1993; Hodgkins and Smith 2002; Leggitt and Cushman 2001); mollusks (Kuchta 2000); and abundant vertebrates including fish (Carvalho et al. 2003; Grande 2001), birds (Leggitt and Buchheim 1998; Leggitt et al. 2001), and mammals (Froehlich and Breithaupt 1998; Gunnell 2003; Zonneveld et al. 2000). According to Grande (1984), fossil insects and plants are the most common fossils from the Green River Formation in the Uintah Basin in Utah. Vertebrate fossils from the Green River Formation in the Uintah Basin are less studied (and less abundant) than those from the Green River Formation in Wyoming.

Sandstone-Limestone Facies

The sandstone-limestone facies is comprised of alternating regularly bedded fine-grained pale grayish-red to grayish-orange sandstone, shale, and white-weathering marlstone and limestone (Dane 1954). In Indian Canyon, the unit is about 700 feet thick. The sandstone-limestone facies grades upward into and intertongues eastward with alluvial rocks of the Uinta Formation (Bryant et al. 1989). The sandstone-limestone facies of the Green River Formation contains plant and invertebrate (insect and mollusk) fossils, and less common vertebrate fossils including mostly fishes, and is designated PFYC Class 4 per the ANF Geologist.

Saline Facies

The saline facies consists of alternating beds of soft clayey, finely flakey brown shale and beds of harder marlstone. Empty molds of ―salt" crystals are extremely abundant and are relicts of two dozen different authigenic sodium minerals (Dyni et al. 1985). Chert nodules are extremely abundant and sandstone beds are more common in the upper half of the unit. In Indian Canyon, which is located approximately 10 miles west of the Project Area, the unit is more than 900 feet thick (Dane 1954). The base of the saline facies is defined differently by different researchers but all place it near the ―tuff zone" of the Evacuation Creek Member: at the top of the tuff zone (Dane 1954), at the base of the tuff

zone (Dyni et al. 1985), and 49.2 feet (15 meters) above the base (Bryant et al. 1989). The upper contact of the saline facies is defined as the uppermost extent of the mottled texture resulting from the salt crystals (Bryant et al. 1989). Fossils are uncommon in the saline facies, but include plants and invertebrates including mollusks and insects. The unit is overlain by the sandstone-limestone facies. Bryant et al. (1989) noted that the base of the sandstone-limestone facies is marked by the first occurrence of fish fossils, suggesting vertebrate fossils are rare or unknown in the saline facies. The saline facies of the Green River Formation is designated PFYC Class 3 by the BLM.

Upper Member

In northeastern Utah, the Parachute Creek Member is composed of sediments that were mostly deposited in deepwater facies, typically consisting of thin-bedded marlstone, oil shale, siltstone, sandstone, and tuff (Cashion 1967). Bryant et al. (1989) and Witkind (1995) placed the Mahogany oil shale bed at the base of the Upper member of the Green River Formation, and the Horse Bench Sandstone in the approximate middle of the Upper member, making the Upper member roughly equivalent with the Parachute Creek and Evacuation Creek members of Bradley (1931) and Cashion (1967, 1973). Fossils of the Parachute Creek Member include a diversity of plants (leaves, fruits, seeds, and wood); an ichnofossil record consisting of bird, mammal, and insect tracks (Moussa 1968); an inferred spider web with spiders and insects (Coddington 1993); bird feathers (unpublished paleontological data, University of Colorado Museum, compiled in 2002); and fish. Recently, researchers from the Denver Museum of Nature and Science have been collecting well-preserved plant fossils from Parachute Creek Member quarries in the southeastern Uintah Basin, some of which are on display in the Utah Field House of Natural History Museum in Vernal. This member, which has minimal exposures in the very southwestern corner of the Project Area, has been designated as PFYC Class 4 by the BLM.

3.4.1.4 Known Paleontological Resources

Paleontological locality searches were conducted of the paleontological database maintained by the Utah Geological Survey and the records of the Geology Museum at Brigham Young University. Neither institution had any recorded paleontological localities from within the Project Area.

Sandau (2005) described a new flora from the Uinta Formation in Wells Draw, a few miles east of the Project Area. His field area, however, did not extend into the South Unit boundary (Sandau 2008). A brief field reconnaissance was conducted by the Forest Service in the South Unit of the ANF for paleontological resources as part of an earlier EA (Forest Service 2005a). Most outcrops of the Uinta and Green River formations examined during this reconnaissance were devoid of obvious fossils. Significant fossil resources identified tended to be restricted to a few relatively thin shale and marlstone layers. Brief, site-specific paleontological is conducted for all Operator-proposed well sites during or following Forest Service on-site visits, with additional follow-up surveys or collection activities as deemed necessary to identify and protect potentially significant fossil resources. For the bulk of the proposed or constructed well sites, no significant paleontological resources were identified as a result of these efforts. The few potentially significant fossil resources that were identified from these efforts have been collected and properly curated for public benefit and scientific study.

3.4.2 Environmental Consequences

The loss of any fossil that could yield information important to earth history, or that embodies the distinctive characteristics of a type of organism, environment, period of time, or geographic region, would be an adverse environmental impact. Adverse impacts on paleontological resources primarily concern the destruction of non-renewable paleontological resources and the loss of information associated with these resources.

Direct impacts on surface or subsurface paleontological resources are the result of destruction by breakage, crushing, and/or burial, typically in construction-related excavations. Surface disturbance also has the potential to adversely impact (destroy) fossils. Impacts as a result of both surface and subsurface disturbance typically result in the loss of contextual paleontological data (e.g., stratigraphic position, depositional environment, taphonomy) that could be recorded if properly salvaged and documented.

The potential for direct impacts on both surface and subsurface paleontological resources is directly proportional to the amount of surface disturbance associated with a project in paleontologically sensitive formations. The higher amount of disturbance associated with construction of well pads, roads, and pipelines, the greater the potential for adverse impacts on paleontological resources.

Indirect impacts typically occur as the result of the construction of new roads in areas that were previously less accessible. This increase in public access increases the likelihood of the loss of paleontological resources through vandalism and unlawful collecting. Human activities that result in an increase in erosion cause indirect impacts through increases in exposure of subsurface fossils and their destruction via weathering. Indirect impacts can be reduced, but not eliminated, with the use of design elements and mitigation measures.

At the programmatic level, it is not possible to evaluate areas of higher paleontological sensitivity with respect to locations of proposed surface disturbance (well pads, access roads, and pipelines) because these specific locations have not yet been determined. Nevertheless, it is known that the Project Area is underlain by geologic units of differing paleontological sensitivity as designated by the PFYC system (see Table 3-19). In this impacts analysis, the total acreage of proposed surface disturbance to each paleontological sensitivity class is calculated for each alternative.

3.4.2.1 Impacts Common to All Alternatives

The types of direct and indirect impacts that are anticipated by the proposed development are common to all alternatives. However, the magnitude of the impacts varies according to the amount (acreage and depth) of disturbance to paleontologically sensitive formations within the Project Area; these disturbances are detailed in the following sections. Design elements common to all alternatives except the No Action Alternative (Alternative 1) that affect paleontological resources are discussed below.

Conditions for a paleontological monitor are included in the proposed design elements and mitigation measures and are as follows:

> A qualified paleontologist would monitor construction activities for proposed well pads and their access roads if shallow or exposed bedrock is present that is potentially fossil-bearing. If significant paleontological resources are discovered, construction activities would be halted and the Forest Service notified. Operations in the area of the discovery would not

resume until authorization to proceed has been received from the Forest Service.

This general mitigation measure minimizes direct impacts to paleontological resources. The need for paleontological monitoring would be determined using the more detailed programmatic mitigation measures provided in Section 3.4.2.8.

Another design element includes the closure of all oil and gas (i.e., new construction) roads to public travel. Closure signs would be placed at the entrance to new roads and gates would be erected where feasible. These actions would minimize public access to previously inaccessible areas and, therefore, reduce indirect impacts.

Erosion control design elements would also serve to reduce indirect impacts associated with destruction of paleontological resources from weathering.

3.4.3 Direct and Indirect Impacts

Direct and/or indirect impacts would occur under all alternatives, and correlate directly to the amount (acreage and depth) of surface disturbance in areas underlain by paleontologically sensitive geologic units. Direct and indirect impacts could be reduced with the implementation of paleontological resource mitigation measures (Section 3.4.2.8).

3.4.3.1 Alternative 1 – No Action Alternative

Under the No Action Alternative, no new direct impacts to paleontological resources would be anticipated as the result of construction-related ground disturbance. Indirect effects could still occur as the result of public access to fossils via existing roads and travel routes, but the probability of such illegal activities would remain constant.

Currently, existing disturbance from roads and other development has affected 158 acres within the South Unit Project Area: 76 acres (48%) within PFYC Class 5 geologic units, 33 acres (21%) within Class 4 geologic units, 8 acres (5%) within Class 3 geologic units, and 40 acres (26%) within Class 2 geologic units. The No Action Alternative has the lowest potential for direct and indirect impacts on paleontological resources, both overall and specifically on PFYC Class 4 and Class 5 geologic units, of all the alternatives.

3.4.3.2 Alternative 2 – Proposed Action

Under the Proposed Action, 1,361 acres of total new surface disturbance are proposed: approximately 796 acres (58%) within PFYC Class 5 geologic units, 391 acres (28%) within Class 4 geologic units, 51 acres (4%) within Class 3 geologic units, and 123 acres (9%) within Class 2 geologic units. The Proposed Action has the highest potential for direct and indirect impacts on paleontological resources, both overall and specifically on PFYC Class 4 and Class 5 geologic units, of all the alternatives.

3.4.3.3 Alternative 3

The BMPs included in Alternative 3 limiting construction to slopes less than 25%, and allowing multiple wells per well pad, could lessen the direct impacts by reducing the amount of potentially fossiliferous rock disturbed. This reduction would be a result of two factors: 1) the construction of fewer well pads (via the use of directional drilling) resulting in less overall disturbed acreage, and 2) less volume of rock disturbed in construction of a given well pad because lower relief locations require less leveling to reach grade.

If these BMPs are applied in areas of high paleontological sensitivity (PFYC Class 4 or 5), it would reduce the amount of potentially fossiliferous bedrock disturbed and, therefore, lessen the potential direct impacts. The reduction of roads associated with drilling multiple wells from one well pad could also reduce indirect impacts by decreasing access to paleontologically sensitive areas.

The phased drilling and POD proposed under this alternative would have no effect on the paleontological resources.

Under Alternative 3, 1,355 acres of total new surface disturbance are proposed: 790 acres (58%) within PFYC Class 5 geologic units, 380 acres (28%) within Class 4 geologic units, 30 acres (2%) within Class 3 geologic units, and 155 acres (12%) within Class 2 geologic units. Alternative 3 has the second highest potential for direct and indirect impacts on paleontological resources, both overall and specifically on PFYC Class 4 and Class 5 geologic units, lower than only the Proposed Action.

3.4.3.4 Alternative 4

Under Alternative 4, 836 acres of total new surface disturbance are proposed: 501 acres (60%) within PFYC Class 5 geologic units, 211 acres (25%) within Class 4 geologic units, 29 acres (4%) within Class 3 geologic units, and 94 acres (11%) within Class 2 geologic units. Of all the action alternatives (the Proposed Action and Alternatives 3 and 4), this alternative has the lowest likelihood of direct and indirect impacts on paleontological resources due to limited surface development, which minimizes potential direct and indirect adverse impacts.

3.4.4 Cumulative Impacts

In general, under all alternatives, impacts to paleontological resources within the Project Area would be low if mitigation measures were implemented to salvage the resources. Therefore, this project would not contribute to significant cumulative impacts to paleontological resources in the region. The recommended mitigation measures would effectively recover the value to science and society of significant fossils that would otherwise have been destroyed by surface-disturbing actions or by natural weathering and erosion processes.

3.4.5 Mitigation

Direct adverse impacts can typically be mitigated to below a level of significance through implementation of paleontological mitigation. Mitigation also creates a beneficial impact because it results in the salvage of fossils that may never have been unearthed intact or undamaged via natural processes. With mitigation, these newly salvaged fossils become available for scientific research, education, display, and preservation in perpetuity. In addition to the design elements and mitigation measures, the following four programmatic mitigation measures have been developed to reduce direct and indirect impacts on paleontological resources to a less than significant level.

Pre-Construction Assessments

Site-specific surveys would be needed for proposed infrastructure in PFYC Class 4 and Class 5 geologic units (Upper Member of the Green River Formation and Lower Member of the Uinta Formation; see Figure 3-12) in order to a) determine the presence of previously unknown significant vertebrate fossils and/or noteworthy occurrences of invertebrate, plant, or trace fossils on the surface; b) evaluate potential adverse impacts to

subsurface paleontological resources during construction; and c) make recommendations for further site-specific mitigation measures including, if warranted, monitoring or spot-checking during ground-disturbing construction activities.

During field surveys, any significant surface fossils identified at that time would be collected and documented, and all fossil localities would be recorded. The results of the field surveys would be compiled in an assessment report, including recommendations for additional paleontological mitigation work, if any, and including construction monitoring requirements if deemed appropriate. All fossils collected would be transferred to a Forest Service-approved paleontological repository for curation, accompanied by a copy of the paleontological assessment report. Typical recommendations made in an assessment report would include one or more of the following:

If adverse impacts on paleontological resources are anticipated to be non-existent or below the level of significance for a given surface-disturbing action, and no further consideration of paleontological resources is deemed necessary, paleontological clearance would be recommended.

If significant (well-preserved, uncommon, and/or identifiable) paleontological resources are known or suspected to be present, or if there is a high likelihood that subsurface fossils are present within a specified project area based on prior field surveys, museum records, or scientific or technical literature, then paleontological monitoring of surface-disturbing actions within that area would be recommended.

During construction, the Project Paleontologist would have authority to downgrade the monitoring level if the sensitivity of the area proves to be less than previously anticipated. If this occurs, construction personnel would be instructed that if any suspected fossils are found, they must immediately cease work in that area and notify their supervisor, who should then contact the Forest Service and Project Paleontologist for further instructions. The Project Paleontologist would then inspect the suspected fossils and make further recommendations in consultation with the Forest Service.

If fossils are discovered within a given project site during field surveys or mitigation monitoring, and they are determined to be scientifically significant, those fossils would be salvaged and properly curated. Fossil salvages typically involve the systematic collection or excavation of fossil remains as determined on a case-by-case basis. Salvage excavations should be designed in such a way as to prevent delays to project schedules to the extent practical, while still ensuring that the fossil resources and associated provenance data are properly protected, collected, and curated.

If the cost of salvage or other mitigation options are determined to be too high, or permanent damage to significant fossil resources would be otherwise unavoidable, it may be necessary for site-specific proposed developments to be moved or rerouted, in order to prevent adverse impacts to those resources. Avoidance should also be considered if a known fossil locality contains critical scientific information that needs to be left undisturbed for subsequent scientific evaluation.

Construction Monitoring

Monitoring of construction activities for significant fossil resources should be conducted or supervised by a qualified Forest Service-approved paleontologist. Such monitoring would take place during any ground-disturbing activities (such as the construction of well pads, roads, pipelines, and other facilities) where construction monitoring was deemed necessary during pre-construction assessments. Construction monitors would follow earth-

moving equipment and examine excavated sediments and excavation sidewalls for evidence of contained significant paleontological resources.

Depending upon the paleontological sensitivity of the area, and on the types and significance of potential fossils being expected or found, monitoring may need to take place continuously during construction activities, or may only require periodic spot-checks of construction excavations. The monitors would have authority to temporarily divert operating equipment away from exposed fossils in order to professionally, safely, and efficiently recover the fossil specimens and collect associated data. Monitors would also have authority to temporarily stop construction activities in the vicinity of exposed fossil resources. All efforts would be made to avoid unreasonable delays to project schedules.

If any suspected fossils are found by construction personnel when no paleontological monitor was present, they must immediately cease work in that area and notify their supervisor, who should then contact the Forest Service and Project Paleontologist for further instructions. The Project Paleontologist would then inspect the suspected fossils and make further recommendations in consultation with the Forest Service. Any significant fossils found and collected would be transferred to a Forest Service-approved paleontological repository and properly curated there, along with relevant information on the location and geologic context for each fossil specimen collected.

Report All Potential Paleontological Resources

If potentially significant paleontological resources are discovered or suspected at any location or time, construction activities would be halted and the Forest Service notified. Operations in the area of the discovery would not resume until authorization to proceed has been received from the Forest Service.

Education on Resource Sensitivity

Most indirect impacts are difficult to mitigate to below the level of significance, but they can be greatly reduced by increasing public and Operator awareness about the scientific importance of paleontological resources through education (training presentations and/or handouts), as well as information about penalties for vandalism and unlawful collecting of these resources from public lands. This mitigation measure, in conjunction with the closure of new roads to public access, would significantly reduce, but not eliminate, indirect impacts to paleontological resources associated with the construction of new roads.

3.5 Soils

3.5.1 Affected Environment

Soils within the Project Area reflect the historical and present conditions of the surrounding environment. Resource indicators used to assess potential impacts to the affected soil resources include the area of disturbance and soil exposure, soil type, and slope. The stability, productivity, and characteristics of soils are influenced by multiple factors, including geologic conditions, geomorphic processes, biologic conditions, climate, location characteristics (elevation, aspect, slope), and anthropogenic activities.

Soil descriptions for the Project Area are based on Land Type (LT) data developed by the ANF (Forest Service n.d.). The LTcharacterization identified and mapped nine soil units. Mapped locations of each LT are provided in Figure 3-13. More detailed soil map unit

descriptions are provided in the Soil, Water, and Geological Resources Specialist Report (found in the project record).

Soil characteristics vary within the Project Area. Textures range from fine-textured soils in the valley bottoms to gravelly and fine-loamy soils on canyon slopes, ridges, and high plateaus. Slopes range from nearly level in valleys and on plateaus to nearly vertical on canyon side slopes. Depth to bedrock is typically less than 50 centimeters on canyon slopes, somewhat deeper on the plateaus, and can be as deep as 20 meters in the valley bottoms (Forest Service 2005a). Soil temperature regimes range from cryic (cooler) to mesic (warmer), and soil moisture regimes range from aridic (extremely dry) to ustic (somewhat dry) (Forest Service 2005a).

Soils in the Project Area have a moderate to high potential for erosion and exhibit active landform processes. Material from the steeper, elevated areas erodes and is transported to the canyon bottoms, forming alluvial fans. Areas with steep slopes or a combination of moderate slopes with fine-loamy particle size have an increased potential for erosion and soil loss. Soils that are susceptible to erosion (when disturbed) tend to be less stable, discouraging the establishment of vegetation.

The susceptibility of soils to compaction is based on the dominant particle size class associated with the LT. LTs with a loamy-skeletal particle size class generally have low compaction potential. LTs with a fine-loamy particle size class have moderate compaction potential. LTs with a fine or clayey-skeletal particle size class generally have high compaction potential. The presence of calcium also increases compaction potential.

The Forest Service soils inventory data do not contain information on the occurrence or types of biological soil crusts that may occur in each LT. Biological soil crusts include mats or filaments of cyanobacteria, lichens, and mosses. These soil crusts play a major role in reducing water and wind erosion and in preventing the establishment of invasive annual grasses (BLM 2001). Biological soil crusts are unlikely to occur on steep slopes or other unstable areas. More stable areas are able to maintain vegetative cover and are more likely to contain biological soil crusts. For more detailed information on biological soil crusts in the Project Area, refer to the Soil, Water, and Geological Resources Specialist Report in the project record.

3.5.2 Environmental Consequences

The actual occurrence, extent, and degree of impacts to soil resources depend on site-specific variables and the specific alternatives being proposed. The expected degree and frequency of impacts on soils cannot be determined until the APD stage of permitting approval. The amount and severity of impacts to soil resources is generally expected to be proportional to the area of soil disturbance and location of that disturbance at any one time. The soils in the project area present challenges for reclamation. For the most part they are shallow or have limited topsoil. The effects of the project proposal as is, are hard to determine and there are unknowns as to the consequences of the degree of disturbance of roads and pads construction. At each new development, the cumulative effects of past projects needs to be assessed. A more detailed discussion of potential impacts is provided in the Soil, Water, and Geological Resources Specialist Report (available in the project record).

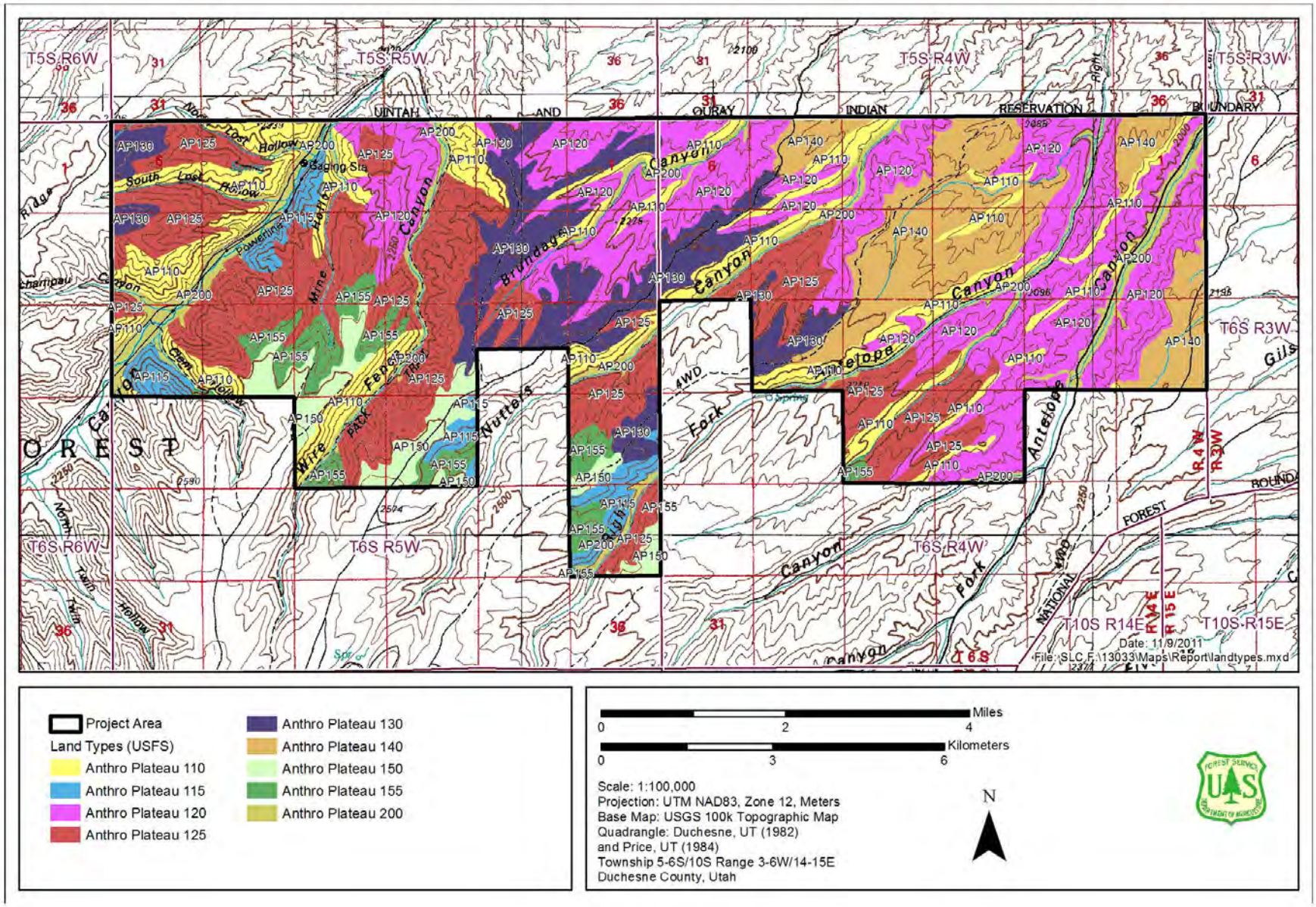


Figure 3-13. Forest Service Land Type Mapping for the Project Area.

3.5.2.1 Impacts Common to All Alternatives

Oil and gas development is typically associated with certain types of potential impacts to soil resources and these potential impacts are applicable to all development alternatives. Direct impacts to soils from the action alternatives include soil destabilization, mass wasting, topsoil loss and mixing of soil horizons, compaction, and contamination of soils with petroleum products or other chemicals.

Soil disturbance and vegetation removal destabilizes soils, and makes the soil more prone to the effects of wind and water erosion. Accelerated erosion can trigger gullying, undercutting, and further destabilization. Effects of the action alternatives are also anticipated to result in increased rates of mass wasting. Mass wasting processes that could potentially be triggered in the Project Area include landslides, slumps, flows, soil creeps, and rock falls.

Topsoil loss and the mixing of soil horizons adversely impacts soil productivity and reclamation potential. Loss of fertile topsoil or the mixing of soil materials can occur during grading, excavation, or reapplication if soil materials are not deliberately handled. Soils in the project area generally have little top soil. The limited amount of top soil for reclamation will need to be considered at the APD stage and part of the reclamation plan.

The reclamation potential of soils is also adversely impacted by compaction. Compaction associated with the action alternatives would occur mainly on well pads and associated roads. These areas would be used long-term for operations and not identified for reclamation in the short term. Therefore, compaction effects on revegetation would not be an immediate concern.

The action alternatives would increase the risk of soil contamination. Oil and gas development activities involve the use and production of substances that can be harmful to soils and reduce soil productivity. Accidental spills or leaks of poor quality produced water, petroleum products, fracturing fluid, or other pollutants can result in soil contamination. All action alternatives would include the implementation of a project SPCCP that would minimize the risk of such spills by detailing techniques to prevent spills, and outlining measures to be taken in the event of a spill.

Biological soil crusts could be disturbed, removed, or buried due to development activities. Data on the prevalence, density, or location of soil crusts on affected LTs is not available so estimates of impacts cannot be quantified. A site-specific evaluation that assesses the presence of biological soil crusts and the soil characteristics (e.g., texture and moisture) at a particular location would be necessary to evaluate impacts and focus mitigation measures.

Under all of the action alternatives, the majority of proposed developments are projected to occur within mapped LTs AP120, AP125 AP130, AP140, and AP200. A moderate amount of development is also projected to occur within LT AP110. However, the potential for actual development within these LTs would be limited by existing lease terms and applied mitigations that limit development in areas with steep slopes, geologic hazards, or unstable soils. Development areas located within LT AP200 but not designated as areas of geologic hazard or unstable soils may still have increased potential for soil impacts such as erosion and low reclamation potential due to the presence of alluvial fans and active geomorphic processes (e.g., debris flows, downcutting) that occur in these areas. Debris flows and other surface movement on the fans are active on the South Unit (Koerner 2008). Because these processes take place in the canyon bottom areas, and are

locations where some of the well pads and other developments could occur, these bottom areas, along with steep slopes, would be considered to contain landforms of concern. The dominant LT map unit for valley bottoms is AP200, which was envisioned by the 1997 Western Uinta Basin Oil and Gas Leasing EIS as having a high potential for geologic hazards.

LTs AP120, AP125, AP130, and AP140 are not as prone to frequent active geomorphic processes and do not typically exhibit a dominance of steep slopes. With the implementation of mitigation measures, these LTs would generally be considered suitable for development. However, some properties of the soil components comprising these LTs, such as shallow development and dry moisture regimes, do contribute to the potential for soil impacts. Localized characteristics of the disturbance location, including slope, aspect, and vegetation, would determine the actual occurrence and degree of impacts. Because site-specific information is not available at the Programmatic EIS level, it is not possible to fully evaluate potential impacts in all locations within the Project Area. When actual well pad and ROW locations are determined, additional evaluation of avoidance and mitigation would be required as determined by the Forest Service authorized officer.

3.5.2.2 Direct and Indirect Impacts

The amount and severity of impacts to soil is expected to be proportional to the area and locations of soil disturbance at any one time. The acreages of surface disturbance occurring in each LT are provided below. Additional details describing potential impacts of all alternatives to soil resources are provided in the Soil, Water, and Geological Resources Specialist Report (available in the project record).

Alternative 1 – No Action Alternative

Under the No Action Alternative, no additional activities would occur that would potentially affect soil resources other than those previously approved for the Project Area. Although no new development would be authorized under this alternative, potential impacts from previously approved field development would occur.

Alternative 2 – Proposed Action

Table 3-20 summarizes soil disturbance for the Proposed Action. Of the 1,361 acres of soil disturbance, approximately 619 acres would take place areas currently mapped within LTs that locally exhibit highly erodible soils and /or soils with poor reclamation potential (AP110, AP115, AP120, AP125, AP155, AP200). However, some of the proposed developments within these map units may be precluded by the lease stipulations and or mitigations for this project. Review of site-specific development proposals would be needed to determine the amount of actual development which might potentially occur within these map units. Disturbance would not occur all at once but is anticipated to occur over an approximate 20-year period.

The Proposed Action includes two standard lease terms (SLT) (Forest Service 1997) relevant to soil resources, which require an NSO stipulation in areas of geologic hazard or unstable soils and precludes development in areas with a high potential of geologic hazard or unstable soils. Avoidance of these areas would reduce soil loss and minimize sedimentation.

Table 3-20. Soil Disturbance in Acres for the Proposed Action.

LT Map Unit	Soil Erodibility	Reclamation Potential	Acres
AP110	High	Poor	120 [2]
AP115	Poor	Poor	19 [2]
AP120	Moderate	Poor to fair	281 [2]
AP125	High	Poor	177 [2]
AP130	Moderate	Fair	224
AP140	Moderate	Fair	237
AP150	Moderate	Good	60
AP155	Moderate	Poor	22 [2]
AP200	High	Poor to fair	217
Total Acres[1]			**1,357**

[1] Individual acreages may not add to total due to rounding.

[2] Some of the proposed disturbance acres within these LT map units may be precluded by lease stipulations or mitigations for this project, or by moving actual disturbances to more favorable locations during site-specific development proposals and or subsequent Forest Service on-site visits.

Alternative 3

Alternative 3 includes phased development, a required plan of development (POD), avoidance of areas with slopes greater than 25%, and mandatory BMPs. Table 3-21 summarizes soil disturbance for each of the possible phases of development as described in Chapter 2. Of the 1,355 acres of soil disturbance, approximately 652 acres would take place in areas currently mapped as having steep slopes, highly erodible soils, and/or soils with poor reclamation potential (AP110, AP115, AP120, AP125, AP155, AP200). However, some of the proposed developments within these map units may be precluded by the lease stipulations and or mitigations for this project. Review of site-specific development proposals would be needed to determine the amount of actual development which might potentially occur within these map units. Site-specific effects on soils cannot be determined until the APD stage of permitting approval, when avoidance and mitigation measures will be determined. Effective implementation of mitigation measures to these effects would minimize impacts but not eliminate all impacts.

The disturbance would occur in phases, as described in Chapter 2 of the FEIS. The disturbance acreages are broken down by location and are summarized in Table 3.

Alternative 4

Alternative 4 would limit surface development to six well pads per section, with an average of four wells per section across the Project Area. Table 3-22 summarizes soil disturbance for Alternative 4. Of the 836 acres of soil disturbance, approximately 340 acres would take place in areas currently mapped as having steep slopes, highly erodible soils and/or soils with poor reclamation potential AP110, AP115, AP120, AP125, AP155, AP200). However, some of the proposed developments within these map units may be precluded by the lease stipulations and or mitigations for this project. Review of site-

specific development proposals would be needed to determine the amount of actual development which might potentially occur within these map units. Site-specific effects on soils cannot be determined until the APD stage of permitting approval, when avoidance and mitigation measures will be determined. Effective implementation of mitigation measures to these effects would minimize impacts but not eliminate all impacts.

Table 3-21. Soil Disturbance in Acres for Alternative 3.

LT Map Unit	Phase	Acres
AP110	Phase 1	26
	Phase 2	15
	Phase 3	21
	Phase 4	10
	Phase 5	23
	AP110 Total	105 [2]
AP115	Phase 2	4
	Phase 5	12
	AP115 Total	18 [2]
AP120	Phase 1	61
	Phase 2	32
	Phase 3	97
	Phase 4	33
	Phase 5	20
	AP120 Total	261 [2]
AP125	Phase 1	26
	Phase 2	22
	Phase 4	21
	Phase 5	81
	AP125 Total	157 [2]
AP130	Phase 2	29
	Phase 3	92
	Phase 4	82
	Phase 5	30

LT Map Unit	Phase	Acres
	AP130 Total	**234**
AP140	Phase 1	69
	Phase 2	145
	Phase 3	28
	AP140 Total	**242**
AP150	Phase 2	6
	Phase 3	1
	Phase 4	10
	Phase 5	15
	AP150 Total	**65**
AP155	Phase 2	2
	Phase 1	2
	Phase 2	2
	Phase 5	13
	AP155 Total	21 [2]
AP200	Phase 1	97
	Phase 2	38
	Phase 3	21
	Phase 4	18
	Phase 5	48
	AP200 Total	**247**
Total Acres[1]		**1,350**

[1] Individual acreages may not add to total due to rounding.
[2] Some of the proposed disturbance acres within these LT map units may be precluded by lease stipulations or mitigations for this project, or by moving actual disturbances to more favorable locations during site-specific development proposals and or subsequent Forest Service on-site visits.

Table 3-22. Soil Disturbance in Acres for Alternative 4.

LT Map Unit	Soil Disturbance (Acres)
AP110	70 [2]
AP115	16 [2]
AP120	128 [2]
AP125	107 [2]
AP130	149
AP140	120
AP150	65
AP155	19 [2]
AP200	146
Total	**820**

[1] Individual acreages may not add to total due to rounding.

[2] Some of the proposed disturbance acres within these LT map units may be precluded by lease stipulations or mitigations for this project, or by moving actual disturbances to more favorable locations during site-specific development proposals and or subsequent Forest Service on-site visits.

3.5.3 Cumulative Effects

The cumulative impact analysis area (CIAA) for soil resources consists of the two watersheds that drain the Project Area. To determine cumulative effects, the effects of project-related activities within the CIAA are added to effects on soil resources resulting from past, present, and reasonably foreseeable future activities within the affected environment. The following activities were considered for cumulative effects on soil resources: ongoing cattle grazing, prescribed burns, habitat enhancement projects, vegetation management, road stabilization, and other existing and future oil and gas development.

Soil resources in the CIAA are affected by existing development both within and outside of the Project Area boundary. Project actions, combined with other surface-disturbing activities currently proposed for the region, would contribute incrementally to soil resource impacts including mixing of soil horizons, compaction, increased susceptibility of the soils to wind and water erosion, and contamination of soils with petroleum products or other chemicals. With the implementation of applicant-committed mitigation measures, the incremental contribution of project-specific impacts from the Proposed Action to cumulative impacts would be minimized.

Cumulative impacts to soil resources are expected to be greatest in watersheds that are common to previous development and the Proposed Action. In the CIAA, these areas include the tribal land within the Antelope Creek and Upper Pariette Draw watersheds, downstream of the Project Area.

3.5.4 Mitigation

Various design elements and mitigation measures were identified in the Decision Notice and Finding of No Significant Impact for the 2006 EA for Berry Petroleum‘s Exploration

and Development Project in the ANF (Forest Service 2006a). These design elements and mitigation measures have been included within the Proposed Action and all action alternatives in order to avoid or minimize potential adverse environmental effects. These measures are above and beyond those required by the Operator‘s lease stipulations. The proposed design elements and mitigation measures that would act to avoid and minimize impacts to soils resources include the following.

- At the beginning of pad construction, surface soils would be salvaged and stockpiled adjacent to the well pad site for future use in site reclamation.
- Cut slopes required for pad construction would not be steeper than 1.5:1. In some cases, additional engineering measures would be implemented to construct drainage systems and culverts in order to divert water flow away from the well pads and roads, prevent erosion, and prevent sediment loading in creek channels due to construction. These locations and engineered designs would be submitted with the site-specific APDs.
- Gas gathering pipelines would parallel access roads in the vast majority of cases and add virtually no additional surface disturbance as they would use the 35-foot road ROW.
- Emergency shutdown equipment would be employed to minimize the risk of spills.
- After completion activities, the Operator would reduce the size of the well pad to the minimum surface area needed for production facilities including adequate room for oil trucks to turn around, while providing for reshaping and stabilization of cut and fill slopes. The cut and fill slopes would be reshaped to mimic the adjacent natural terrain. Reclaimed portions of the pads would be seeded with native vegetation as directed by the Forest Service.
- To prevent erosion of disturbed soils, vegetation and/or structural measures to control erosion would be implemented as soon as possible after initial soil disturbance.
- 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.
- Energy dissipaters such as straw bales and silt fences may be required to prevent excess erosion of soils from disturbed areas to stream channels or floodplains. These structures would be installed during construction, and would be left in place and maintained for the LOP or until the disturbed slopes have revegetated and stabilized.
- During the construction phase of the project, the Operator would implement an intensive reclamation and weed control program after each segment of project completion. The Operator would reseed all portions of well pads and road and pipeline ROWs not used for the operational phase of the project. Reseeding would be accomplished using native plant species indigenous to the Project Area. Post-construction seeding applications would continue until determined successful by the Forest Service. Weed control would be conducted through an approved Pesticide Use and Weed Control Plan from the AO. Weed monitoring and reclamation measures would be continued on an annual basis (or as frequently as the AO determines) throughout the LOP.
- Stream/drainage crossings for new roads would be designed so they would not cause headcutting, siltation, or the accumulation of debris in the channel. Plans for crossings

would be submitted and subject to Forest Service engineer approval before construction may begin. Other permit requirements/coordination required for crossings may include: U.S. Army Corps of Engineers 404 permitting and State of Utah 401 permitting.

- At the end of its productive life, each well pad would be recontoured to mimic the adjacent natural topography using heavy equipment and previously salvaged soil material would be spread over the surface of the pad site. The reclaimed surface would then be reseeded with vegetation; the seed mix would be determined by the Forest Service and would generally mimic native vegetation surrounding the specific well site. Assure sufficient erosion control when adequate groundcover is reestablished, water naturally infiltrates into the soil, and gullying, headcutting, slumping, and deep or excessive rilling is not observed. Well site reclamation would be performed and monitored in consultation with the ANF, including the control of noxious weeds. Well site reclamation would be performed and monitored in accordance with the Standard Surface Use Plan detailed in the Operator‘s MDP (Appendix A).
- Detailed site specific transportation plans will be submitted with each application to drill. Transportation plans will include detailed route locations, drawings, gates, signage, erosion control, drainage, road maintenance, etc.

3.6 Water Resources

3.6.1 Affected Environment

Water resources within the Project Area with the potential to be affected by the proposed project include surface water and groundwater (including seeps and springs).

Potential effects on water quality for surface water are indicated by changes in the concentrations of water quality parameters. Surface water quality parameters of concern in the Project Area are total suspended solids, TDS, selenium, and boron. Changes to the physical hydrology of groundwater would be indicated by fluctuations in water table levels or changes to pumping yields in nearby water wells. Morphological changes to channels and drainage networks, including accelerated gullying, rill erosion, and sediment delivery to streams, are additional potential effects of the proposed actions to water resources. These impacts are related to both water quality and the physical hydrology of water resources. The indicators of stream miles and watershed acres disturbed are used to assess these impacts.

3.6.1.1 Surface Water

The Project Area is located on the north-draining slope of the Tavaputs Plateau in the Green River Basin. Most of the streams within the Project Area are located in the Antelope Creek watershed and drain northeast to the Duchesne River. A smaller portion of the Project Area, located in the southeastern-most corner, drains to Gilsonite Draw, a tributary to Pariette Draw in the Upper Pariette Draw watershed. Approximately 98% of the Project Area is located in the Antelope Creek watershed, with the remaining 2% located in the Upper Pariette Draw watershed (Figure 3-14). Both watersheds drain to the Duchesne River, a tributary to the Green River, which ultimately flows into the Colorado River.

The Project Area consists of a series of southwest- to northeast-trending ridges and canyons with intermittent and ephemeral washes draining predominantly to the northeast.

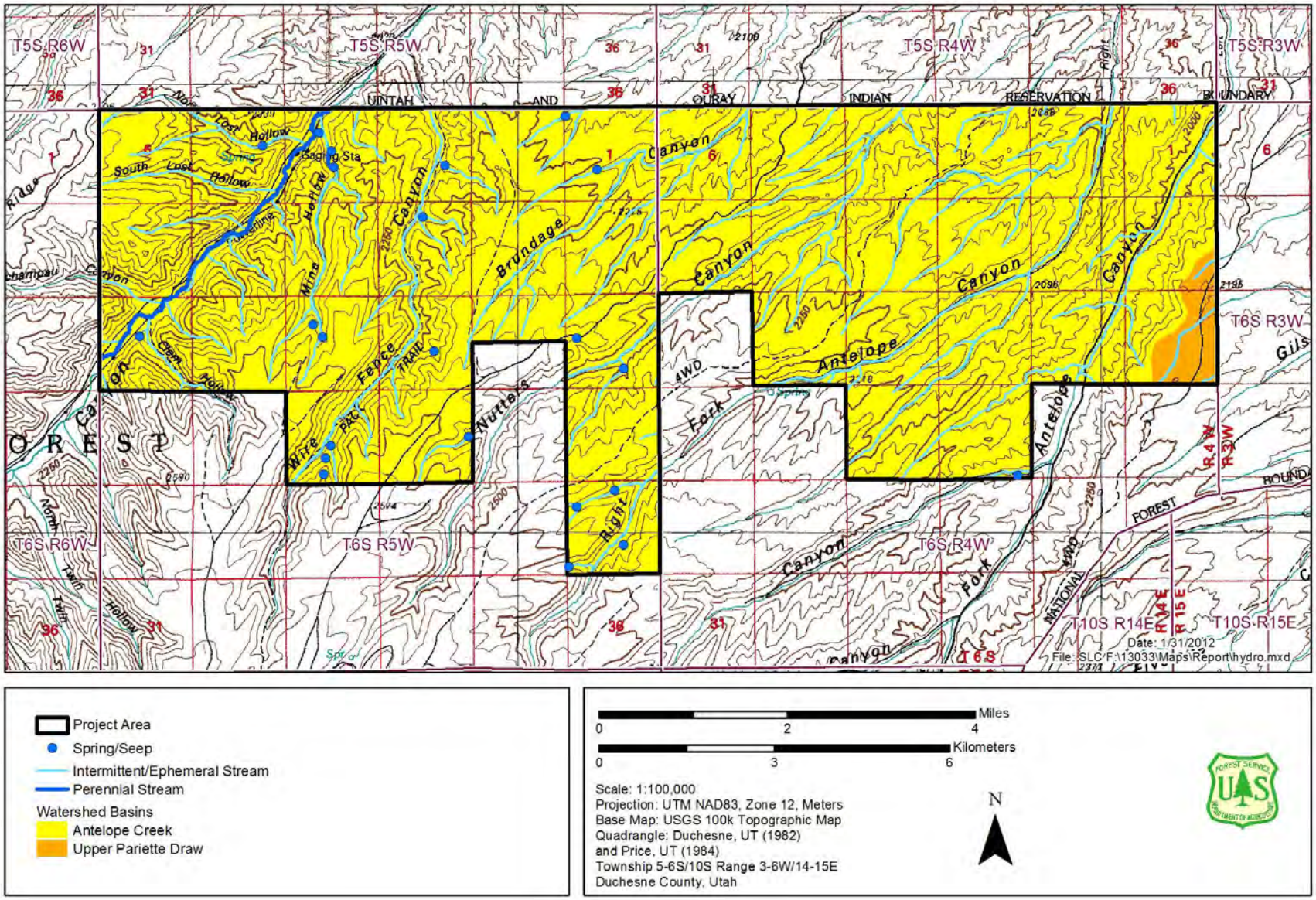


Figure 3-14. Watersheds within the Project Area.

Table 3-23. Descriptions of Channels within the Project Area.

Name	Flow Frequency	Channel Description	Erosion and Gullying	Named Tributaries in Project Area
Gilsonite Draw	Intermittent	Low-gradient with moderately steep side slopes. Flat-bottomed and broad in the lower section changing to V-shaped and narrow in the upper reaches.	Mostly mature, old gullies. Above Forest boundary, gully systems younger and discontinuous, 5-10 feet in depth with active headcuts present.	
Left Fork Antelope Canyon	Intermittent/ ephemeral	Broad and flat-bottomed, becomes narrow and trough-shaped in the upper reaches. Valley bottom gradients are low and the side slopes are steep.	Small, mature to old gully is present from Forest Service boundary to about 2 miles upstream. Above this point, the gully becomes substantially larger (about 50 feet wide and 20 feet deep) with active cutting present.	Alkali Canyon
Right Fork Antelope Canyon	Intermittent	Broad and flat-bottomed, becomes narrow and trough-shaped in the upper reaches. Valley bottom gradients are low and the side slopes are steep.	Discontinuous gully system with depths ranging from 0–25 feet with active cutting present.	
Nutters Canyon	Intermittent/ ephemeral	Broad, flat-bottomed canyon that changes gradually to a V-shaped bottom in the upper third. Side slopes are moderately steep and the gradient is moderate.	Discontinuous gully system (3–10 feet deep) with moderate erosion cutting in the lower half and little or no erosion in the upper half.	
Brundage Canyon	Intermittent	Trough-shaped in the bottom half and V-shaped in the upper half, with moderate side slopes and gradient.	Continuous, mature to old gully system with little active erosion.	
Wire Fence Canyon	Intermittent	Trough-shaped with a moderate gradient and steep sides.	Discontinuous, very mature to old gully system with very little gully activity or erosion. Some small, active headcuts are present.	

Name	Flow Frequency	Channel Description	Erosion and Gullying	Named Tributaries in Project Area
Sowers Canyon	Perennial	Mostly flat-bottomed and broad with a low gradient and steep sides.	Continuous gully system (7–16 feet deep) that is moderately active with some sloughing and cutting.	Mine Hollow lower reaches have seasonal flows in spring and fall; flows continuously some years

From east to west, the major drainages are Gilsonite Draw, Left Fork Antelope Canyon, Right Fork Antelope Canyon, Nutters Canyon, Brundage Canyon, Wire Fence Canyon, and Sowers Canyon. Sowers Creek is the only perennial stream in the Project Area. Table 3-23 summarizes the characteristics of these drainages as described by the ANF (Forest Service 1992, 2006b, 2007b).

The State of Utah has determined that the agricultural and aquatic life designated beneficial uses in waters downstream of the Project Area are impaired due to exceedences of TDS, boron, and selenium (UDEQ 2010a, 2010b). As water flows over and through soil particles and rock, soluble materials accumulate in the water. Major ions in water are sodium, calcium, magnesium, potassium, chloride, sulfate, and bicarbonate. In addition to ions, there are other dissolved substances in water, such as dissolved organic materials. The sum of all of the dissolved substances in water is referred to as the TDS, and is measured in milligrams per liter. Selenium is a naturally occurring trace element, and is both an essential micro-nutrient and potentially detrimental element in high concentrations, which have been shown to cause mortality, deformity, and reproductive failure in fish and aquatic birds (EPA 1998). Boron is a naturally occurring trace element that is essential for the growth of crop plants and some algae, fungi, and bacteria, but can be toxic in excess.

The Utah Division of Water Quality (UDWQ) determined that Antelope Creek is not supporting its agricultural use due to exceedences of TDS and boron. Sowers Creek, a main tributary to Antelope Creek, is naturally a moderate to high source of TDS loading to Antelope Creek. A segment of the Duchesne River downstream of the Antelope Creek confluence is also impaired due to exceedances of TDS. TDS concentrations are elevated in the Duchesne River from the city of Myton, downstream to its confluence with the Green River. The Utah State water quality standards include a numeric criterion of 1,200 mg/L TDS to protect irrigation water. The impairments for the Duchesne River are represented by exceedences of these criteria (Table 3-24).

The UDWQ also determined that Pariette Draw (of which Gilsonite Draw in the Project Area is a tributary) is not supporting its agricultural use due to violations of water quality criterion for elevated boron and TDS concentrations (Table 3-25), and not supporting its warm water fisheries and waterfowl classification due to exceeding the chronic standard for selenium.

Table 3-24. Summary of Water Quality Data for Parameters of Concern for Creeks in and Directly Downstream of the Project Area in the Antelope Creek Watershed.

	TDS[1] mg/L			Boron[3] µg/L		
Creek	**Antelope Creek**	**Sowers Creek[2]**	**Duchesne River**	**Antelope Creek**	**Sowers Creek**	**Duchesne River**
STORET Station ID	493423	493425	493419	493423	493425	493419
Standard	1,200	1,200	1,200	750	750	750
No. Samples	23	29	132	7	2	11
Avg	2,012.61	997.52	665.63	4,439.28	2,625	735.91
Min	334	720	186	235	2,390	294
Max	2,764	1,364	2,222	6.310	2,860	1,220
Total No. of Violations	22	5	7	6	2	5
Percent Violating	95.65%	17.25%	5.30%	85.71%	100%	45.45%

[1] TMDLS for Total Dissolved Solids in the Duchesne River Watershed (UDEQ 2007).
[2] Sowers Creek data (Berry Petroleum 2009)
[3] STORET data downloaded from storet.epa.gov
µg/L = micrograms per liter
mg/L = milligrams per liter

A Total Maximum Daily Load (TMDL) for the TDS impairment in Antelope Creek and the Duchesne River was completed by UDWQ and approved by EPA in July 2007 (UDEQ 2007). More recently, a TMDL was completed by UDWQ and approved by EPA in 2010 for TDS, selenium, and boron in the Pariette Draw watershed (UDEQ 2010a). Table 3-26 summarizes the load reductions required for these parameters in Antelope Creek, Pariette Draw, and Duchesne River. The numeric criterion of 1,200 mg/L was used as the water quality target for the TMDL analysis. However, UDWQ has recommended to EPA a site-specific standard for Antelope Creek. The Utah Standards of Quality for Waters of the State provide for development of site-specific TDS standards where the adjustment does not impair designated beneficial uses. Data for Antelope Creek during times of ―natural" conditions, prior to manmade changes to support irrigation in the area, are not available. A determination was made in the Duchesne River watershed TMDL (UDEQ 2007) that the TDS criterion of 1,200 mg/L is likely to be unattainable for Antelope Creek due to a combination of naturally saline soils and irreversible modifications from irrigation activities. The proposed site-specific TDS criterion for Antelope Creek is 2,655 mg/L (UDEQ 2007). This site-specific criterion would support the affected designated uses of irrigation and stock watering. As of July 2011, the EPA had not approved the recommended TDS criterion (UDEQ 2011).

According to the Duchesne River TMDL assessment, expected sources of TDS in Sowers and Antelope Creeks are natural conditions (geology), streambank destabilization, oil and gas activities, and irrigation practices. According to the Pariette Draw TMDL assessment, the potential sources of TDS, boron, and selenium are derived from natural geologic formations prevalent throughout the watershed with additional anthropogenic pathways such as subsurface agricultural return flows, animal feeding operations, oil and gas

activities, streambank erosion, and channelization. In both documents oil and gas activities were listed as potential pollutant sources based on the production of saline waste water and evidence in the past of illicit discharges of production water throughout the Uintah Basin. Both documents recognize that current standards require the collection and transport of production water to approved disposal facilities. The Pariette Draw TMDL document cites oil and gas activity being prevalent in the watershed, but does not consider it a major source of TDS, boron, and selenium loading based on observations of best management practices being employed in the field (UDEQ 2010a).

Table 3-25. Summary of Water Quality Data for Parameters of Concern for Creeks Downstream of the Project Area in the Pariette Draw Watershed.

	TDS mg/L		Selenium µg/L		Boron µg/L	
Creek	**Pariette Draw Above Flood Control Structure**	**Pariette Draw Confluence with Green River**	**Pariette Draw Above Flood Control Structure**	**Pariette Draw Confluence with Green River**	**Pariette Draw Above Flood Control Structure**	**Pariette Draw Confluence with Green River**
STORET Station ID	4933480[1]	4933440[1]	4933480[1]	4933440[1]	4933480[1]	4933440[1]
Standard	1,200	1,200	4.6	4.6	750	750
No. Samples	51	95	43	72	23	52
Avg	2,257	2,818	7.4	3.9	1,279	168
Min	684	662	1.0	0.5	421	92
Max	4,262	6,146	21.9	18.0	1,830	3,000
Total No. of Violations	38	87	23	18	19	51
Percent Violating	75%	92%	52%	25%	83%	98%
Total Violations 2006 to Present	22	30	9	5	11	20
Percent Violating 2006 to Present	73%	100%	56%	26%	69%	100%

[1] TMDLs for Total Dissolved Solids, Selenium, and Boron in the Pariette Draw Watershed (UDEQ 2010a)
[*] STORET data downloaded from storet.epa.gov
µg/L = micrograms per liter
mg/L = milligrams per liter

Table 3-26. Summary of TMDL Load Reductions Required for Surface Waters Downstream of the Proposed Project.

	Antelope Creek	Duchesne River		Pariette Draw	
STORET Monitoring Point	493423	493405	4933480	4933480	4933480
Pollutant of Concern	TDS	TDS	TDS	Boron	Selenium
Water Quality Target	1,200 mg/L	1,200 mg/L	1,200 mg/L	750 µg/L	4.6 µg/L
Current Load	Not calculated	225,062[1] kg/day	174.77[2] tons/day	137.98[2] tons/day	0.23[2] lbs/day
Loading Capacity	Not calculated	184,961[1] kg/day	59.85[2] tons/day	64.68[2] tons/day	0.17[2] lbs/day
TMDL Load Reduction	Not calculated	40,101[1] kg/day	114.91[2] tons/day	73.30[2] tons/day	0.07[2] lbs/day
Percent Reduction	0%	18%	65.8%	53.1%	28.1%

[1] Load over the 0 to 30% flow percentile range
[2] Load over the 10 to 40% flow percentile range
µg/L = micrograms per liter
kg = kilogram
lbs = pound
mg/L = milligrams per liter

The USGS, along with the Bureau of Reclamation and the BLM, developed a dissolved-solids water quality model (SPARROW) specific to surface waters in the Upper Colorado River Basin (UCRB) (Kenney et al. 2009). This model relates measured chemical constituents at monitoring stations to upland catchment attributes, such as land use, land cover, or geology (Smith et al. 1997). The model is a statistical assessment based on an existing transport model and available water-quality monitoring data for the basin. Of the 22 factors considered in the model, the largest factors influencing TDS concentrations in surface waters in the UCRB were attributed to the following.

1. **Bedrock geology.** Bedrock geology, particularly sedimentary rock formed from marine sediments, is the largest natural source of dissolved solids to streams in the UCRB (Iorns et al. 1965; Liebermann et al. 1989; U.S. Department of the Interior 2003; Anning et al. 2007; Kenney et al. 2009). Due to its chemical composition, exposure, and erodibility, Uinta formations present significant natural sources of soluble salts (UDEQ 2010a). It contains coal-bearing beds, formed in coastal

marine environments. Coal beds are a known contributor of increased TDS in surface and groundwater.

2. **Climate characteristics.** The major land to water transport mechanism associated with natural sources of dissolved solids is precipitation. Evaporative transpiration is another mechanism that can enhance the transport of dissolved solids to streams. Evaporative transpiration is the process of transferring water to the atmosphere through evaporation of water and transpiration from plants. Vegetation consumes water containing dissolved solids from within the soil zone and transpires pure water leaving behind the dissolved minerals. Evaporation on bare soils also removes pure water and precipitates minerals on the soil surface, which are immediately available for dissolution through precipitation and surface runoff.
3. **Irrigated agriculture.** Irrigation water and natural precipitation in excess of soil holding capacity and plant requirements percolates through the soils and transport these pollutants into the shallow alluvial aquifer (groundwater) eventually returning to the watershed streams as base flow. Deposition of salts on the ground surface also seals the soil pores preventing percolation and increasing the volume and velocity of runoff leading to sheet flows and increased pollutant loading. Irrigation of agriculture lands, particularly those derived from sedimentary rocks, is the major anthropogenic source of dissolved solids in the UCRB, accounting for about 40 percent of the dissolved-solids load (Iorns et al. 1965; Liebermann et al. 1989; U.S. Department of the Interior 2003; Kenney et al. 2009). Irrigation return flows in the watershed are a potential source of salinity because they dissolve and transport soil particles and salts from fields and return them to surface waters through surface and subsurface flows.

The primary sources of boron in Antelope Creek, as noted in Utah‘s draft 2010 303(d) list are agriculture, habitat modification (other than hydromodification), and natural sources though a more detailed TMDL analysis has yet to be conducted. The primary natural source of boron in the area is bedrock formed from evaporated swamps and marshes. The Uintah Basin was once covered by Uinta Lake and eventually evaporated to marshlands before finally disappearing. Shallow groundwater transport is an important transport pathway of boron in the area (Naftz et al. 2008). Boron concentrations in groundwater are derived from leaching of rocks and soils that contain borate and borosilicate minerals. The highest boron concentrations in Pariette Draw occur from November through March which suggests that groundwater contributions are responsible for the majority of the boron impairment and that storm water runoff generally dilutes the concentrations in surface waters.

The sources of TDS, boron, and selenium in the Pariette Draw watershed, as noted in Utah‘s draft 2010 303(d) list are natural sources, agriculture, habitat modification other than hydromodification, irrigated crops and livestock (grazing or feeding operations). The primary natural source of selenium in the area is found in black shale derived soils and landscapes (UDEQ 2010a). Black shale is comprised of organic-rich, fine-grained sedimentary rock deposited in very low oxygen conditions. Dry conditions make irrigation necessary for nearly all crops grown in the watershed. Normal aqueous chemical processes, enhanced by seepage from irrigated agriculture in the watershed, are capable of transporting some of the naturally occurring selenium in the sediments to the stream system. In the 2008 Parriette Draw TMDL assessment, observed selenium concentrations indicate that soil particles and salts are transported to Pariette Draw through irrigation return flows and shallow groundwater (subsurface) flows (UDEQ 2010a). Selenium

concentrations follow a similar pattern to boron, with higher concentrations in the winter months November through March which suggest that groundwater contributions are responsible for the majority of the selenium impairment and that surface water runoff generally dilutes the concentrations in surface waters. Natural seeps in the area provide another pathway for selenium to move from geologic deposits to surface water; as does direct erosion of selenium containing sediments.

More detailed information on surface water is provided in the Soil, Water, and Geological Resources Specialist Report (available in the project record).

3.6.1.2 Groundwater

Groundwater in the Project Area is primarily associated with the Uintah-Animas aquifer of the Colorado Plateau aquifer system. In the Project Area, the principal water-yielding units of the Uintah-Animas aquifer are present in the Uinta and Green River formations. Accessible groundwater is also present in superficial unconsolidated deposits located in thin, narrow, and discontinuous alluvium found in canyon bottoms and stream valleys in the Project Area. The geologic units exposed at the surface in the Project Area are all associated with either the Uintah-Animas aquifer or the unconsolidated stream deposits.

Additional water-bearing units extend throughout the entire stratigraphic sequence (see Figure 3-11) with varying degrees of productivity and water quality. Major aquifer systems below the Uintah-Animas Aquifer include the Mesaverde Aquifer, comprised of the North Horn Formation, Price River Formation, Castlegate Sandstone, and Blackhawk Formation, and the Dakota-Glen Canyon Aquifer System, which lies below the Mancos Shale confining unit and is comprised of the Dakota Sandstone, Morrison Formation, Entrada Sandstone, and the Glen Canyon Sandstone/Nugget Sandstone (USGS 1995).

Most of the drilling targets under the Proposed Action will likely be within the Green River Formation, within the Uintah-Animas Aquifer. There are known confining units both within and below the Uintah-Animas Aquifer. The Parachute Creek Formation forms a confining unit between the Uinta Formation and the Douglas Creek-Renegade portions of the Green River Formation. The Wasatch Formation forms a confining unit between the Green River Formation and the lower Mesaverde Aquifer units (USGS 1996).

The depth to groundwater depends upon topographic position. Near discharge areas in stream beds, the groundwater table may be at or just below the surface. In highland areas that are removed from streams or other sources of recharge, the depths to groundwater are much greater, with the water table occurring as deep as 500 feet (Robson and Banta 1995).

The primary source of natural groundwater recharge is the infiltration of snowmelt in higher elevation areas of the basin. Subsurface flow of the recharge occurs downward and laterally, passing through a system of permeable zones and leaking through less permeable confining units. Within the Project Area, movement of groundwater and discharge is expected to occur generally northward towards the Duchesne River. The Project Area itself is located on the southern flank of the Uintah Basin. While portions of the Project Area are relatively high in elevation (8,000 amsl) and receive more precipitation than the lower portions of the basin, this area is not considered a primary area of recharge for the basin. Most recharge for the Uintah Basin comes from the Uintah Mountains on the north flank of the basin (USGS 1996; Utah Geological Survey 2003).

The quality of the groundwater depends on the chemical and physical attributes of the material through which the water passes, the length of time the water is in contact with this material, and other conditions such as temperature and pressure. In the vicinity of the

Project Area, the primary groundwater quality issue is dissolved solids. A map of chemical quality of groundwater in Price and Waddell (1973) indicates that the Project Area contains at least one aquifer with groundwater that has a relatively low dissolved solids content ranging from approximately 250 mg/L to 1,000 mg/L. However, other aquifers (e.g., deeper aquifers) in the Project Area may contain more mineralized water with higher concentrations of dissolved solids. Recent sampling conducted by the Operator on two water supply wells in Brundage Canyon indicates the presence of higher concentrations of dissolved solids. Source Well 3-24 (located in Section 24, T5S, R5W) was sampled in 2001 and contained a TDS concentration of 5,593 mg/L. Source Well 9-23 (located in Section 23, T5S, R5W) was sampled in 2009 and contained a TDS concentration of 9,162 mg/L. More detailed information on groundwater is provided in the Soil, Water, and Geological Resources Specialist Report (available in the project record).

Aquifers with potable water quality that could be at risk from oil and gas development are defined by regulations in two ways. The EPA designates SSAs in areas where over 50 percent of the drinking water comes from a single aquifer source. There are three such aquifers designated in Utah: the Castle Valley Aquifer System, the Glen Canyon Aquifer System, and the Western Uinta Arch Paleozoic Aquifer System. None of these designated SSAs are located within the Project Area (EPA 2011).

The UDEQ Division of Drinking Water Source Protection Program identifies public water sources and drinking water source protection areas around these sources. The DWSPZ is the surface and subsurface area surrounding a well, spring, or tunnel through which contamination is likely to move toward and pollute a source. There are no public water sources identified within the Project Area, and no DWSPZs extend into the Project Area (UDEQ 2010c).

In addition to public water sources (which are wells, springs, or surface-water intakes used by public water systems), only three other potential water users are located within the Project Area, based on data compiled by the Utah Division of Water Rights. All are surface water sources (spring, creek, or reservoir), and none are used for domestic or municipal supply, only for stock or irrigation uses.

The presence of saline water is prevalent throughout the Uintah Basin, occurring in all aquifer systems. In general, salinity increases with depth, although lenses of fresh water can be found even in saline formations. Injection disposal of produced water typically targets saline formations with greater than 10,000 mg/L dissolved solids. A map showing the depth at which saline groundwater is typically encountered was published in 1987 (Utah Department of Natural Resources 1987), based on some water quality samples and interpretation of geophysical logs. While this map is used to locate acceptable injection zones, the limitations of this map are widely recognized and an effort is currently underway by to update the map using much more extensive water quality sampling; however, these data were not yet available as of July 2011 (Utah Department of Natural Resources 2011).

Within the Project Area, the 1987 map indicates that the depth of saline water varies widely, from 6,000 to 7,000 feet along the western side of the Project Area to within a few hundred feet of the ground surface in the middle of the Project Area.

Within the State of Utah, the withdrawal and use of groundwater is required to have a valid water right; the Operator has or will obtain water rights for any wells. In addition, if groundwater is withdrawn that is considered connected to surface flow; the portion that does not return to the aquifer is considered a depletion of the Colorado River system. Any

water depletion requires U.S. Fish and Wildlife Service (USFWS) consultation for Colorado River Endangered Fishes. Depletions associated with projects on federal land have required payment of a depletion fee to offset the impact on threatened and endangered species in the Colorado River system. Depletions less than 100 acre-feet per year are considered small depletions and do not require fees, nor do depletions considered historic or existing. Consultation with FWS indicated that approximately 200 acre feet of water would be required over the life of the proposed project with a maximum of 40 acre feet per years (USFWS 2012).

3.6.2 Environmental Consequences

The actual occurrence, extent, and degree of impacts to water resources depend on site-specific variables and the specific alternatives being proposed. The amount and severity of impacts to water resources is generally expected to be proportional to the area of soil disturbance at any one time and the amount of freshwater consumed by project activities. A more detailed discussion of potential impacts to water resources is provided in the Soil, Water, and Geological Resources Specialist Report (available in the project record).

3.6.2.1 Impacts Common to All Alternatives

Activities associated with the action alternatives may result in impacts to water resources. Potential impacts include altered drainage or flow patterns. There would likely 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 adsorbed onto sediments can be transported into the surface waters along with the sediment and impact water quality. However, the project will comply with storm water regulatory requirements that mandate use of BMPs to minimize impacts to water quality. The Utah storm water permitting process for construction activities and oil and gas operations would ensure consistency with the approved TMDLs for Antelope Creek and Pariette Draw and compliance with Utah Water Quality Standards (UDEQ 2008). Thus, the proposed project would be consistent with Utah Water Quality Standards.

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 UCRB; nor is surface erosion the primary transport pathways for selenium and boron. The selenium and boron impairments in Pariette Draw occur primarily during low flow periods rather than during storm or runoff events. The highest concentrations of selenium and boron in the Pariette Draw watershed are observed between the months of November and March when there is very little precipitation and therefore very little surface erosion occurs (UDEQ 2010c). The primary pathways for selenium are from irrigation drainage on irrigated lands and groundwater transport. Groundwater transport appears to be the primary transport mechanism for boron in the Antelope Watershed, 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). This watershed includes a portion of the project area and is adjacent to the Antelope Creek watershed. In addition, 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 sites were included in the analysis: 4933440 (Pariette Draw 1 Mile above

confluence with the Green River), 4933480 (Pariette Draw 1/3 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. During this period of increased well development no statistically significant association between average or geomean concentrations of total dissolved solids, total suspended solids, boron, or selenium was found for three sample sites. Interpretation of these findings could reflect the larger influence of natural geology, irrigation practices and other anthopogenic variables masking influence of oil and gas related disturbance on these readings. The results could indicate that utilization of best management practices has reduced the effects below levels detected on a broad watershed scale. Or it could indicate the increase of in oil and gas related disturbance in the water sample period was not of sufficient size or degree to be detected in water quality readings at a watershed level scale.

With adherence to BMPs, mitigation measures, and design elements identified in this proposal, it is unlikely a measurable watershed-scale change in water quality would result from the proposed oil and gas development alternatives; however localized impacts to water quality in individual washes and tributary streams are possible. The degree of these impacts would depend upon the size and density of surface disturbance as well as its proximity to water bodies. As a means of comparing the potential effects between the proposed alternatives, impacts were characterized in terms of acres of watershed and miles of stream disturbed by each alternative in the sections that follow. These numbers were derived by overlaying conceptual development layouts (access routes and pads) with the streams data layer in GIS. Depending on the alternative chosen, the actual location and layout of access routes and pads would reflect lease stipulations, mitigation measures, and Forest Service guidance during the APD stage. Actual acres and miles of stream disturbed would be less than those reflected in the estimates derived here. However, the use of conceptual layouts is useful as a means of comparing and analyzing the relative potential effects between each alternative.

Soil compaction resulting from development activities leads to increased runoff and inhibits vegetative growth and recovery. Runoff on compacted surfaces such as roads or well pads is conveyed at higher velocities than would occur with overland flow on undisturbed surfaces, resulting in increased erosion and sediment loading. The processes can lead to changes in drainage patterns and channel morphology.

Potential impacts to groundwater quality resulting from hydraulic fracturing could potentially occur. Groundwater contamination from an aquifer of lower quality (generally located at greater depths) to an aquifer of better quality (generally located at a shallower depth) could result if fractures in the confining units are formed. Specific requirements for management of hydraulic fracturing is largely absent from current regulations, with studies only recently being undertaken by the EPA to determine the risks associated with fracturing. Current well design and drilling techniques consider these potential effects and incorporate controls (e.g., casing) to minimize the potential for movement of any materials outside the well casing and across aquifers.

The water that is extracted and produced as a by-product of both fracturing and development would likely contain high concentrations of TDS and other pollutants. Under proper management these fluids do not pose a risk to surface water or groundwater sources, except in the event of an accidental spill. Accidental spills or leaks of poor quality produced water can result in the release of pollutants into surface water and

groundwater. Likewise, accidental spills of petroleum products or other pollutants can adversely impact water quality.

The consumption and degradation of freshwater are other potential impacts of this type of development. Freshwater is used in drilling and completion operations. Depending on the amount of water needed and the source of the water, development-associated withdrawals and consumption of freshwater can potentially affect localized water supplies and hydrology. Also, the use of this freshwater in operations can result in a decrease in water quality and the resulting poor quality water must be treated or otherwise properly disposed of.

Based on the lack of any identified public or private potable water sources within the Project Area, and the specific mitigation measures that will be required during the APD process, impacts to these water sources are possible due to accidental spills or fracturing activities but are not likely within the Project Area.

3.6.2.2 Alternative 1 – No Action Alternative

Under the No Action Alternative, no additional activities would occur that would potentially affect water resources other than those previously approved for the Project Area. Approximately 0.7 mile of streams and 168 acres of watershed area have been disturbed by existing roads and well pads. Under the No Action Alternative, the types of water resource impacts that would continue as a result of existing disturbance are similar to those discussed in Section 3.6.1. These impacts would be expected to continue at current rates.

3.6.2.3 Alternative 2 – Proposed Action

Types of impacts to water resources from the Proposed Action would be similar to those described in Section 3.6.1. These impacts include stream and bank erosion, increased volume and velocity of runoff, sedimentation, changes to channel morphology, consumption of water supplies, and localized increases in total sediment. The rates of occurrence and frequency of those impacts would be expected to increase over current conditions. Disturbance would not occur all at once but is anticipated to occur over an approximate 20-year period.

Under the Proposed Action, 1,361 acres of watershed area would be potentially disturbed by surface disturbance from access roads and infrastructure. The miles of road/pipeline stream crossings were determined by overlaying the Alternative 2 conceptual development layout with the streams data layer. Surface disturbance along streams would amount to 7.8 miles, with 0.3 mile of disturbance in Sowers Canyon (perennial) and 7.5 miles occurring along intermittent streams. Surface disturbance would amount to 1,361 acres, with 1,345 acres in the Antelope Creek watershed and 16 acres in the Upper Pariette Draw watershed.

Impacts to water resources related to the consumption of fresh water for operations are expected to be minimal. Though water from the Petroglyph Operating Company 08-04 Waterplant and the Arcadia Feedlot are derived from groundwater sources (Forest Service 2006a), through consultation with the Fish and Wildlife Service it is expected small depletions to the Duchesne River system would occur as a result of the Proposed Action (< 100 acre-feet per year). In the absence of data proving otherwise, connectivity of this source to surface waters of the Duchesne River system must be assumed. As such, consultation with the Fish and Wildlife Service will be required. Consumption estimates

based on project design constitute a small depletion. No diversions of any perennial or ephemeral surface water drainages within the Project Area would occur. As a result, no effects to drainage or river health from changes in stream flow related to water consumption would occur within the project area. No groundwater wells are proposed in the Project Area and therefore no alterations to the groundwater or localized aquifer depletions are expected.

3.6.2.4 Alternative 3

Implementation of Alternative 3 is anticipated to result in 1,355 acres of watershed surface disturbance (8.3 miles of surface disturbance to intermittent streams, 0.4 mile of surface disturbance to perennial streams). Disturbance from the construction of access roads and infrastructure would occur in phases, as described in Chapter 2. BMPs proposed as part of this alternative would help avoid development near sensitive resources and could reduce the overall surface disturbance required to develop the 400 wells. Surface disturbance within watersheds would amount to approximately 1,355 acres, with 1,339 acres in the Antelope Creek watershed and 16 acres the Upper Pariette Draw watershed. Impacts on fresh water supplies would be the same as those discussed for the Proposed Action.

Potential disturbance for road/pipeline stream crossings would amount to 8.7 miles, with 0.4 mile of disturbance in Sowers Canyon (perennial) and 8.3 miles occurring along intermittent streams. This was determined by overlaying the Alternative 3 conceptual development layout with the streams data layer.

3.6.2.5 Alternative 4

Alternative 4 would limit surface development to an average of four well pads per section, but up to six well pads per individual section as topography permits. This would result in a maximum of 162 well pads across the Project Area but each well pad could be up to 3 acres in size. Impacts on fresh water supplies would be the same as those discussed for the Proposed Action because the same amount of wells would be drilled. Implementation of Alternative 4 is anticipated to result in 836 acres of watershed surface disturbance. Disturbance would occur over a 5- to 20-year drilling phase, as described in Chapter 2. Surface disturbance from the construction of access roads and infrastructure would amount to approximately 836 acres, with approximately 823 acres in the Antelope Creek watershed and approximately 13 acres the Upper Pariette Draw watershed.

Potential disturbance for road/pipeline stream crossings would amount to approximately 3.6 miles, with 0.2 mile of disturbance occurring in Sowers Canyon (perennial) and 3.4 miles occurring along intermittent streams. This was determined by overlaying the Alternative 4 conceptual development layout with the streams data layer.

3.6.3 Cumulative Impacts

Other proposed activities on the South Unit of the ANF include ongoing cattle grazing, prescribed burns, habitat enhancement projects, vegetation management, road stabilization, and other existing and future oil and gas development. Many of these activities are designed to improve watershed conditions. Existing and future oil and gas development, however, contributes to cumulative adverse impacts on water resources. These ongoing and future activities could alter existing stream flows by temporarily removing/altering vegetation composition and increasing potential for erosion and sediment loading to adjacent streams. The Proposed Action and other oil and gas drilling

currently proposed for the region would cumulatively add to these impacts by disturbing additional soil surfaces, introducing the potential for spills of petroleum products, and using and degrading fresh water supplies in the region.

3.6.3.1 Surface Water Mitigation

Various design elements and mitigation measures were identified in the Decision Notice and Finding of No Significant Impact for the 2006 EA for Berry Petroleum‘s Exploration and Development Project in the Ashley National Forest (Forest Service 2006a). These design elements and mitigation measures have been included within the Proposed Action in order to avoid or minimize potential adverse environmental effects. These measures are above and beyond those required by the Operator‘s lease stipulations. A detailed MDP is provided in Appendix A. The proposed design elements and mitigation measures that would act to avoid and minimize impacts to surface water resources include the following.

- 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.
- 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.
- Energy dissipaters such as straw bales and silt fences may be required to prevent sediment delivery from disturbed areas to stream channels or floodplains. These structures would be installed during construction, and would be left in place and maintained for the LOP or until the disturbed slopes have revegetated and stabilized.
- To assess the potential impact of the project on Sowers Creek, the Operator would annually or semi-annually monitor the stream for phenols, nutrients, boron, and sediment-related indicators.
- 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 20-mil pit liner on top of a protective felt layer to minimize the potential for pit fluid leaks.
- During the construction phase of the project, the Operator would implement an intensive reclamation and weed control program after each segment of project completion. The Operator would reseed all portions of well pads and road and pipeline ROWs not used for the operational phase of the project. Reseeding would be accomplished using native plant species indigenous to the Project Area. Post-construction seeding applications would continue until determined successful by the Forest Service. Weed control would be conducted through an approved Pesticide Use and Weed Control Plan from the AO. Weed monitoring and reclamation measures would be continued on an annual basis (or as frequently as the AO determines) throughout the LOP. Herbicides shall be selected from those approved for use on the ANF.
- Road drainage crossings for new roads would be designed so they would not cause siltation or the accumulation of debris in the drainage crossing nor would the drainages be blocked by the roadbed.

Recommended mitigation measures, including those identified in the Duchesne River and Pariette Draw TMDLs, to avoid and minimize adverse impacts to water resources are:

- A minimum distance of 100 feet will be maintained between surface disturbing activity and springs or seeps, as measured from the outer edge of their associated wetland/riparian vegetation.
- reserve pits would not be constructed in areas of shallow groundwater and natural watercourses;
- well pads would not be developed on steep slopes (including but not limited to NSO slopes), stream corridors, formerly irrigated lands, or highly erodible soils (k factor greater than 0.37);
- pits and well sites would be reclaimed back to natural condition by revegetating with biologically active topsoil;
- Culverts in perennial streams would be designed to allow for passage of aquatic organisms.

The reach of the Duchesne River from Myton to the confluence with the Green River has been identified by the UDEQ as being impaired for dissolved solids, and a TMDL has been specified for TDS (Tetra Tech 2007). Part of the reduction strategy is to implement irrigation and riparian BMPs, including BMPS for runoff management for controlling excess runoff caused by construction operations at development sites, changes in land use, or other land disturbances. These BMPs are applicable to the Proposed Action. Recommended BMPs cover a wide range of actions, including passive and active management, and mild, moderate, and intense engineering. Many of the BMPs described above that will be implemented by the Operator are similar to those designated as mild engineering practices, and are consistent with the recommendations included in the TMDL for reduction of dissolved solids in the Duchesne River.

3.6.3.2 Groundwater Mitigation

Mitigation measures with respect to groundwater are incorporated as part of the approval process for individual wells. As the agency responsible for lease issuance and administration, the BLM will 1) assist in reviewing site-specific APDs for adequacy and 2) assist in developing COAs, BMPs, mitigation measures, and monitoring requirements. BLM‘s review is guided by BLM Instruction Memorandum UT 2010-055, Protection of Ground Water Associated with Oil and Gas Leasing, Exploration, and Development – Utah BLM.

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. Lease notices and COAs, attached to an APD, will be applied to lands overlying EPA-designated SSAs and state of Utah DWSPZs, and include coordination with the public water source owner to identify mitigation and monitoring plans. As previously discussed, there are no SSAs or DWSPZs located within the Project Area.

A site-specific analysis of groundwater and its protection would be conducted during BLM‘s review of an APD, regardless of the presence of an SSA or DWSPZ. Onshore Oil and Gas Order No. 1, Approval of Operations, is authorized by 43 CFR 3160 and contains the requirements for a complete APD package. The requirements are:

- a completed Form 3160-3 APD;

- well plat certified by a registered surveyor;
- drilling plan;
- surface use plan of operations;
- evidence of bonding;
- operator certification; and
- completion of an onsite inspection.

The Proposed Action is based on the drilling and surface use plans submitted by the Operator. The drilling plan includes a description of the drilling program; projected completion zone locations; pertinent geologic data; estimated depths at which the top and bottom of anticipated water, oil, gas or other mineral-bearing formations are expected to be encountered and plans for protecting such resources; expected hazards and proposed mitigation measures to address such hazards. The surface use plan of operations includes maps showing existing roads to be used for access, new access to be constructed, location of existing wells (including private water wells), locations of existing and/or proposed facilities, location and type of water supply to be used during drilling and well site layout, including reserve pit location and type of liner if necessary. Information must be supplied regarding the source of construction materials for the road and pad, location of auxiliary facilities, methods of handling waste disposal, name of the surface owner, occurrence of shallow groundwater, and plans for reclamation of the surface.

In accordance with 43 CFR 3162.3-1, Drilling Applications and Plans, wells would be approved only after appropriate environmental and technical reviews by the BLM AO. Permitting is a site-specific process. A thorough review of materials submitted with an APD for each individual well will be completed by BLM resource specialists. The geologist and/or hydrologist would perform independent review utilizing Utah Geological Survey and USGS geologic and hydrologic data and maps to generate a geologic report. The geologist and/or hydrologist would identify all usable groundwater and mineral-bearing zones that require protection, including SSAs and DWSPZs. The petroleum engineer reviews the casing and cementing portions of the drilling plan to ensure the protection of those zones identified by the geologic report. The natural resource specialist reviews the surface use plan and determines the adequacy of reserve pit design. COAs will be attached to the APD as necessary. An on-site inspection involving company representatives, the Forest Service IDT, the BLM IDT, UDOGM personnel, and, for split estate, the surface owner or other land management agency, is required to be conducted prior to approval. BLM and UDOGM specialists also inspect the constructed pad site before drilling begins.

Usable groundwater resources are protected during drilling in accordance with BLM Onshore Oil and Gas Order No. 2, Drilling Operations, and UDOGM Administrative Rules. Onshore Order No. 2 requires that all formations containing usable quality water (≤10,000 mg/L TDS) be isolated and protected utilizing cement. A COA would be attached to the APD that states, ―If encountered while drilling, usable quality water requires protection by bringing the cement at least +/- 100‘ above the usable water quality zone.” The COA would specify the anticipated formation and depth at which the usable quality water might be encountered. BLM petroleum engineers and petroleum engineering technicians conduct inspections to ensure that the operator‘s plans have successfully avoided environmental impacts. Petroleum engineering technicians inspect well sites during drilling, completion, and production for technical and safety compliance.

In accordance with 43 CFR 3162.4-2, Samples, Tests and Surveys, ~~"~~during the completion of a well, the operator shall, when required by the authorized officer (AO), conduct, test, run logs and make other surveys reasonably necessary to determine the presence, quantity, and quality of oil, gas, other minerals, or the presence or quality of water." These tests and logs are reviewed and correlated with geologic and hydrologic data. ~~"~~When needed, the operator shall conduct reasonable tests which will demonstrate the mechanical integrity of the down-hole equipment" (43 CFR 3162.4-2[b]). In order to protect fresh water and other minerals, ~~"~~tests and surveys of the effectiveness of such measures (to isolate and protect usable water) shall be conducted by the operator using such procedures and practices approved or prescribed by the AO." The BLM has the authority to require companies to do reasonable testing if deemed necessary. The BLM AO may require an operator to conduct cement bond log surveys to verify cement adequacy.

The Gold Book - Surface Operating Standards and Guidelines for Oil and Gas Exploration and Development (fourth edition, revised 2007) incorporates the 43 CFR 3160 regulations. To prevent contamination of groundwater and soils, or to conserve water, the BLM suggests that operators use a semi-closed-loop drilling fluid system or line reserve pits with an impermeable liner if pits are constructed in areas of shallow groundwater or porous soils over fractured bedrock. If the AO determines it is necessary, as verified during the on-site survey or permit review, the BLM would attach a COA requiring the use of a semi-closed-loop drilling fluid system or the lining of the reserve pit at the time of APD approval.

Onshore Oil and Gas Order No. 7, Disposal of Produced Water (43 CFR 3162.5 – Environment and Safety), specifies informational and procedural requirements for submission of an application for the disposal of produced water and the design, construction and maintenance requirements for disposal pits. All produced water from federal leases must be disposed of by 1) injection into the subsurface which is regulated by the EPA or UDOGM within the underground injection control (UIC) programs; 2) into pits which are regulated by BLM or UDOGM; or 3) other acceptable methods approved by the AO, including surface discharge under the National Pollutant Discharge Elimination System as regulated by 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 Part 17.2253.

Produced water must be disposed of in a pit or evaporation pond, i.e. disposal facility, that conforms to approved construction requirements in accordance with Onshore Order No. 7, BLM Manual 9172, and UDOGM or EPA requirements. After construction, the facility must be determined to be acceptable by the AO prior to discharge of fluids. The BLM AO may impose additional conditions or revoke a previously approved disposal permit.

Operators are encouraged to substitute less toxic, yet equally effective chemicals, for conventional drilling products such as mud and pipe dope. Containment structures are to be constructed around all tank batteries consistent with EPA's SPCCP regulations. All spills or leakages must be reported immediately by the Operator to the BLM in accordance with Notice to Lessees NTL-3A.

Application of stipulations and lease notices and the above guidance, regulations, Onshore Oil and Gas Orders, and COAs will effectively eliminate, reduce, or mitigate potential impacts to groundwater sources.

With respect to the potential accidental spill of produced water or fracturing fluids, the Proposed Action would include the implementation of a project SPCCP that would minimize the risk of such spills by detailing techniques to prevent spills, and outlining measures to be taken in the event of a spill.

3.7 Wetlands and Riparian Areas

3.7.1 Affected Environment

Wetlands are lands between terrestrial and aquatic systems where substrates are at least periodically saturated with water (Cowardin et al. 1979). According to the U.S. Army Corps of Engineers (USACE), a wetland is defined as having hydrophytic vegetation, hydric soil, and hydrologic indicators (USACE 1987). Wetlands that meet these three criteria are referred to as jurisdictional wetlands and are regulated by the USACE under Section 404 of the Clean Water Act (CWA).

Sowers Creek is the only perennial stream in the Project Area, and is also the only stream that contains wetland characteristics and riparian habitat. In general, the Sowers Creek channel is entrenched, resulting in a relatively narrow active floodplain, which is submerged during peak flows. Wetland characteristics, including wetland vegetation, hydric soils, and wetland hydrology, do occur along Sowers Creek; however, these characteristics are restricted in many places by the entrenched nature of the stream channel and only occur immediately adjacent to flowing water. According to ANF vegetation data, approximately 121 acres of riparian habitat occur in the Project Area, exclusively along Sowers Creek. Small wet areas with hydric vegetation that do not necessarily meet all the definitions of jurisdictional wetlands are associated with many of the springs and seeps in the Project Area. The remaining canyons in the Project Area contain dry washes with no characteristics of wetlands or riparian habitat.

Floodplains of creeks are present within the numerous canyon bottoms within the Project Area. All canyon waters within the area originate on the southern boundary of the ANF above the Badland Cliffs, and then flow generally northward and discharge into either the Gray Mountain Canal or the Duchesne River. Flows in both tributary and major drainages within and surrounding the Project Area can reach very high levels in a relatively short time period, especially after storm events. Floods may occur in response to late summer storms and spring runoff.

3.7.2 Environmental Consequences

3.7.2.1 Impacts Common to All Alternatives

Wetlands and riparian areas would be avoided in compliance with Section 404 of the CWA, EOs 11988 or 11990, the LRMP (Forest Service 1986), and the Western Uinta Basin Oil and Gas Leasing ROD (Forest Service 1997b).

3.7.2.2 Alternative 1 – No Action Alternative

Under the No Action Alternative, no additional impacts to riparian areas and wetlands other than those previously approved for the Project Area would occur.

3.7.2.3 Alternative 2 – Proposed Action

Because wetland and riparian areas in the Project Area would generally be avoided, no significant impacts to wetlands, waters of the U.S., or riparian areas are anticipated for the Proposed Action. In some cases, roads and pipelines may cross drainages, possibly impacting wetland/riparian vegetation. Any impacts from these crossings would require a Section 404 permit and would be analyzed by the USACE permit process. Sowers Creek is the only perennial stream in the Project Area and is also the only stream that contains wetland characteristics and riparian habitat. As discussed in the Surface Water section, an estimated 0.3 mile of habitat along Sowers Creek could be affected by Alternative 2. Stream crossings would be analyzed on a project-specific basis during the site-specific APD process and through CWA permitting, if necessary.

3.7.2.4 Alternative 3

Sowers Creek is the only perennial stream in the Project Area and is also the only stream that contains wetland characteristics and riparian habitat. An estimated 0.4 mile of habitat along Sowers Creek could be affected by Alternative 3 due to road/pipeline crossings.

3.7.2.5 Alternative 4

Sowers Creek is the only perennial stream in the Project Area and is the only stream that contains wetland characteristics and riparian habitat. An estimated 0.2 mile of habitat along Sowers Creek could be affected by Alternative 4 due to road/pipeline crossings.

3.7.3 Mitigation

Other than necessary road/pipeline stream crossings, development would be avoided within 100-foot buffers around springs, riparian areas, and wetlands. In addition, lease stipulations for riparian areas include an NSO stipulation in wetlands and riparian areas greater than 40 acres in size (Forest Service 1996a). The LRMP restricts facilities and surface-disturbing activities to areas outside riparian areas (Forest Service 1986). Continued implementation of these stipulations would adequately avoid or minimize impacts to riparian areas and wetlands and prevent erosion and minimize sedimentation into perennial streams.

- In the case of perennial streams (i.e. Sowers Creek) facilities such as well pads, tank batteries, and compressor stations will be located outside the 100-year floodplain or a distance of 150 feet from the high water line, whichever is greater (as per INFISH recommendations for non-fish-bearing perennial streams).
- In the case of intermittent and ephemeral drainages, a minimum distance of 50 feet will be maintained between such facilities and the active channel and cutbanks of adjacent vertical terraces. For priority watersheds, classified as impaired by the Utah Division of Water Quality, siting of facilities within 100 feet of intermittent/ephemeral channels will be avoided where feasible; and where it occurs, would be subject to more rigorous monitoring and implementation of erosion control measures.
- New road and pipeline construction within these buffer zones would be minimized and generally limited to perpendicular or near perpendicular crossings of channels. Additional mitigation measures and road maintenance requirements would apply regarding the design of channel crossings, road drainage, erosion control, and dust abatement.

3.7.4 Cumulative Impacts

Riparian and wetland habitats within the CIAA are found along drainages and stock ponds. Existing and future impacts to these habitats include increased sediment deposition from roads, pipeline crossings, and recreational use, and adverse impacts to the functioning condition of riparian areas due to livestock grazing. Wetlands, waters of the U.S., and riparian areas would be avoided where possible during implementation of this and other proposed projects in the CIAA and are required to comply with Section 404 of the CWA, so no significant direct impacts to these resources are anticipated.

3.8 Vegetation

3.8.1 Affected Environment

High elevations and low annual precipitation are prime determinants of plant species composition, abundance, and distribution within the Project Area. The region is more elevated than the Wyoming Basin to the north and, therefore, contains a far greater extent of pinyon-juniper woodlands. However, the region also has large, low-lying areas containing shrublands typical of hotter, drier areas (Woods et al. 2001). The composition and extent of native plant communities within the Project Area have been modified by livestock grazing, oil and gas development, and other land uses.

A vegetation community map of the Project Area was created from the vegetation cover datasets obtained from the ANF. Pinyon-juniper woodland is the predominant vegetation type in the Project Area. Other major cover types include big sagebrush shrubland, black sagebrush, greasewood, coniferous forest, mountain brush, grassland, riparian, and aspen forest. The boundaries of these cover types are illustrated on Figure 3-15. Vegetation cover types and their aerial coverage are summarized in Table 3-27. All predominant vegetation cover types are described in the following subsections.

Table 3-27. Vegetation Cover Types in the Project Area.

Vegetation Cover Type	Acres	Percent of Project Area
Pinyon-Juniper Woodland	21,284	82%
Big Sagebrush Shrubland	2,022	8%
Black Sagebrush	996	4%
Greasewood	640	2%
Coniferous Forest	310	1%
Mountain Brush	157	<1%
Grassland	155	<1%
Riparian	122	<1%
Rabbitbrush	80	<1%
Aspen Forest	3	<1%
Unknown (not mapped)	131	<1%
Total	**25,900**	**100%**

3.8.1.1 Plant Communities

The following are descriptions of each predominant vegetation type in the Project Area.

Pinyon-Juniper Woodland

These woodlands occur on warm, dry sites on mountain slopes, mesas, plateaus, and ridges. In the Project Area, pinyon-juniper woodlands are often semibarrens with scattered pinyon (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*). The understory often consists of mountain mahogany *(Cercocarpus montanus*), mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*), Wyoming big sagebrush (*A. t.* ssp. *wyomingensis*), and/or bluebunch wheatgrass (*Pseudoroegneria spicata).*

Greasewood

The greasewood community is dominated by black greasewood (*Sarcobatus vermiculatus*). Greasewood is found in the bottoms of canyons and dry washes. Shrubs often form a continuous or intermittent linear canopy in and along drainages. Black greasewood may be intermingled with some basin big sagebrush where deeper soils exist and higher salinity encourages greasewood encroachment. Greasewood often exists in a zone outside the riparian influence of perennial streams.

Coniferous Forest

These forests occur predominantly in cool ravines and on north-facing slopes. Such sites include lower and middle slopes of ravines; along stream terraces; moist, concave topographic positions; and north- and east-facing slopes. Coniferous forests are dominated by Douglas-fir (*Pseudotsuga menziesii)* and include mixed conifer/aspen (*Populus tremuloides*) stands. A number of cold-deciduous shrub species are often associated. Naturally occurring fires are of variable return intervals and are mostly light, erratic, and infrequent due to the cool, moist conditions.

Mountain Brush

Mountain mahogany, mountain snowberry (*Symphoricarpos oreophilus*), and serviceberry (*Amelanchier alnifolia*) are the dominant shrub species in this plant community. This plant community is generally located on steep slopes adjacent to major drainages in the Project Area including Sowers, Wire Fence, and Nutters canyons.

Grassland

Grassland communities occur in lowland and upland areas and may occupy swales, mesa tops, and alluvial flats, but sites are typically xeric. The dominant perennial bunch grasses and shrubs within this system are all very drought-resistant plants. Within the Project Area, grasslands consist predominately of salina wildrye.

Riparian

Riparian forest and shrub communities are generally found along rivers, streams, lakes, and drainages, and are characterized by willows (*Salix* spp.). These communities support distinct plant compositions that are dependent on saturated soils. The only riparian habitat in the Project Area is associated with the stream channels of Sowers Creek.

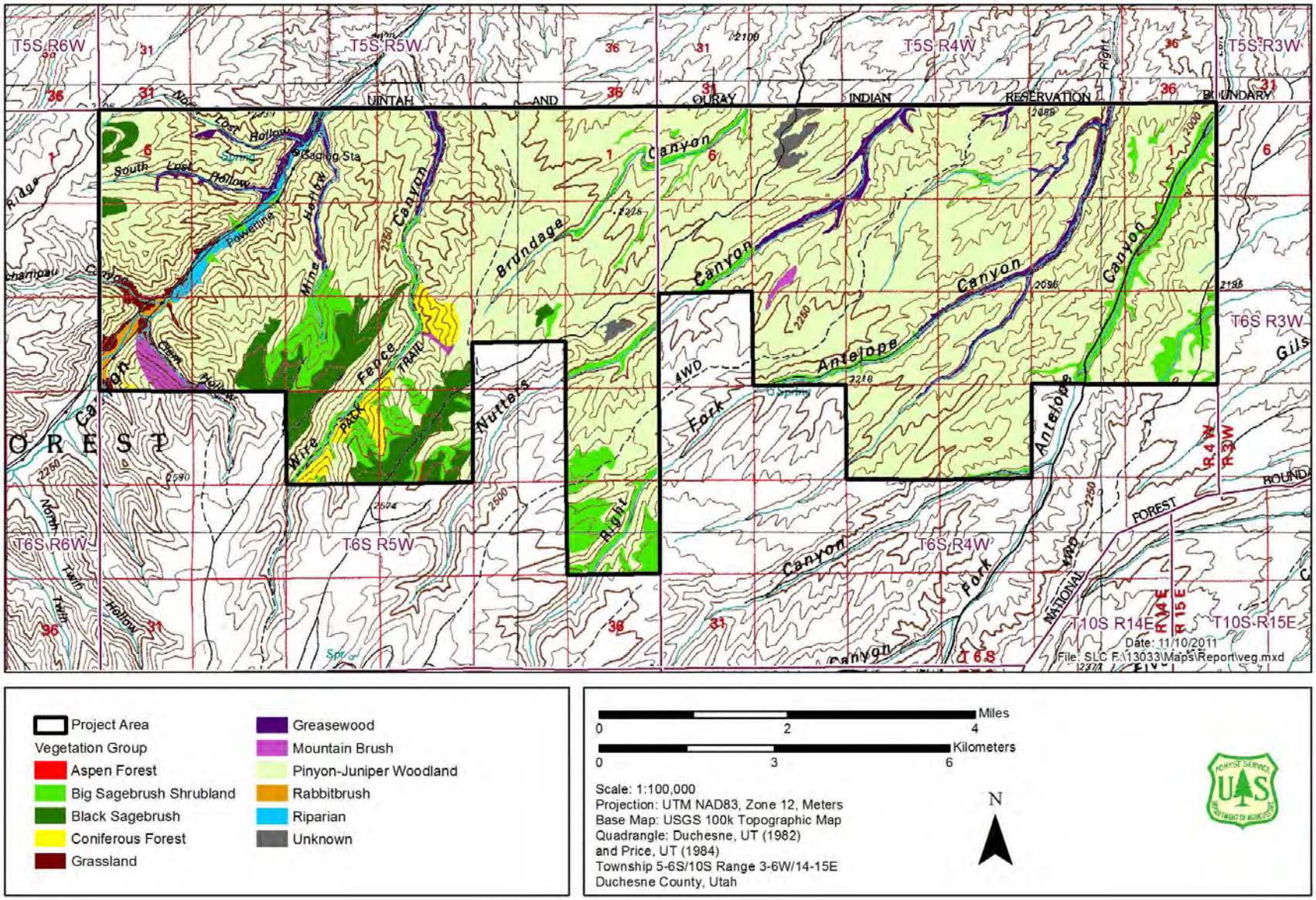


Figure 3-15. Vegetation Cover Types in the Project Area.

Big Sagebrush Shrubland

These shrublands are dominated by basin big sagebrush (*A. t.* ssp. *tridentata*), mountain big sagebrush, or Wyoming big sagebrush. Scattered juniper may be present in some stands within this vegetation type. Thickspike wheatgrass (*Elymus lanceolatus*), blue grama (*Bouteloua gracilis*), basin wildrye (*Leymus cinereus*), and salina wildrye (*L. salinus*) are graminoid species commonly associated with big sagebrush shrublands.

Black Sagebrush

Black sagebrush (*A. nova*) is the dominant species within this vegetation class, and is commonly associated with bluebunch wheatgrass and/or salina wildrye. Soils associated with black sagebrush tend to be drier and are generally shallower than soils supporting big sagebrush shrubland (Kitchen and McArthur 2007).

Rabbitbrush

The dominant plant in this community type is rubber rabbitbrush (*Chrysothamnus nauseosus*). Rubber rabbitbrush favors sunny, open sites and is particularly common on disturbed sites.

Aspen Forest

These are upland forests dominated by aspen without a significant conifer component. The understory structure may be complex with multiple shrub and herbaceous layers, or simple with just an herbaceous layer. The herbaceous layer is dominated by graminoids or forbs. Associated shrub species include mountain snowberry and wild rose (*Rosa woodsii*). Occurrences of this system originate and are maintained by stand-replacing disturbances such as avalanches, crown fire, insect outbreak, disease, wind throw, or clearcutting by humans or beaver (*Castor canadensis*), within the matrix of conifer forests. Aspen forests occur in the southern portion of the Project Area where elevations are the highest. They occur as islands typically surrounded by sagebrush.

3.8.1.2 Noxious, Non-Native, and Invasive Plant Species

EO 13112 (Invasive Species) was signed by President Clinton in 1999. The primary purpose of this EO is to prevent the introduction of invasive species and provide for their control in order to minimize economic, ecological, and human health impacts. Noxious weeds are officially designated as non-native plant species that are invasive and/or can become monocultures and cause harm to land value, native ecology, agricultural interests, wildlife habitat, livestock forage, riparian resources, and aesthetic and visual land values. An invasive plant is an introduced species that has the ability to thrive and spread aggressively outside its natural range. The spread of invasive, non-native plant species contributes to reduced structural and species diversity, loss or fragmentation of wildlife habitat, reduced visual character of an area, and economic impacts due to loss of rangeland productivity and control costs.

Table 3-28 presents a list of noxious weeds known to exist in the Project Area. Noxious weed surveys were conducted by the ANF in the summer of 2010. Weeds are most common in areas that have been disturbed (such as roadsides), areas that have been overgrazed, or in drainages where wildlife and/or livestock congregate. Noxious weed locations in the Project Area are illustrated on Figure 3-16 (actual areas of weed occurrences are enlarged for better visibility). Large infestations of musk thistle (*Carduus nutans*) occur in the southern portion of the Project Area in Nutters and Right Fork Antelope canyons. Smaller infestations of whitetop (*Cardia draba*) and Russian knapweed

(*Acroptilon repens*) occur in Wire Fence and Sowers canyons, respectively. Sources of invasion include gravel obtained from outside the Project Area and soil carried to the area on vehicles (e.g., drill rigs, construction equipment, and recreational vehicles) as well as birds and wildlife.

3.8.1.3 Forest Service Sensitive Plant Species

U.S. Forest Service Manual 2670 direction requires analysis of potential impacts to sensitive species, which are species identified by the Regional Forester for which population viability is a concern. Extensive surveys have been conducted in the South Unit for rare plants (Utah Department of Natural Resources Division of Wildlife Resources [UDWR] 1998). Three sensitive plant species are known to occur in the South Unit of the ANF. These species are Untermann daisy (*Erigeron untermannii*), Goodrich's blazingstar (*Mentzelia goodrichii*), and Green River greenthread (*Thelesperma caespitosum*). Occurrence records, including known locations of rare plants within the South Unit, were obtained from the Utah Natural Heritage Program (UNHP). There are known populations of Untermann daisy and Goodrich's blazingstar within the Project Area. A list of sensitive plant species that were evaluated for occurrence in the Project Area is presented in Table 3-29.

Extensive inventory and monitoring for sensitive plants has been conducted on the South Unit of the ANF over the past 25 years by Allen Huber and Sherel Goodrich, Forest Service botanists. The intensity of inventories varied across the landscape, however, monitoring locations are found in essentially all community types. The density of monitoring locations is high in drainage bottoms and on ridges. Results of these inventories show that sensitive plants in the vicinity of the Project Area are generally found at higher elevations and in the breaks of Argyle Canyon (Goodrich 2010).

Untermann daisy occurs in 17 populations around Sowers Canyon in the northwest corner of the Project Area. It is confined to ridge tops or the sides of ridges near ridge crests where marl mudstone is abundant (Goodrich 2010). Franklin (1989) describes the substrate as ~~"a~~ mixture of fine textured sandy-silty soil and flat, angular fragments that have weathered from the sandstone, shale, and siltstone that make up the Uinta Formation in the western part of the Uintah Basin." Extinction risks for Untermann daisy may stem from its restricted range, relatively few populations, steep declines in population numbers, or other factors (Utah Natural Heritage Program [UNHP] 2005).

Goodrich's blazingstar is a local endemic that is confined to the steep shale slopes of the Green River Formation. An occurrence of Goodrich's blazingstar is located just outside the western boundary of the Project Area on the west wall of Sowers Canyon. No plants have been found within the Project Area on the canyon bottom. Several populations are known to occur along the escarpment of Willow and Argyle canyons outside of the Project Area (UDWR 1998). Extinction risks for this species have been described as very high and may be due to extreme rarity, very steep declines in populations, or other factors (UNHP 2005).

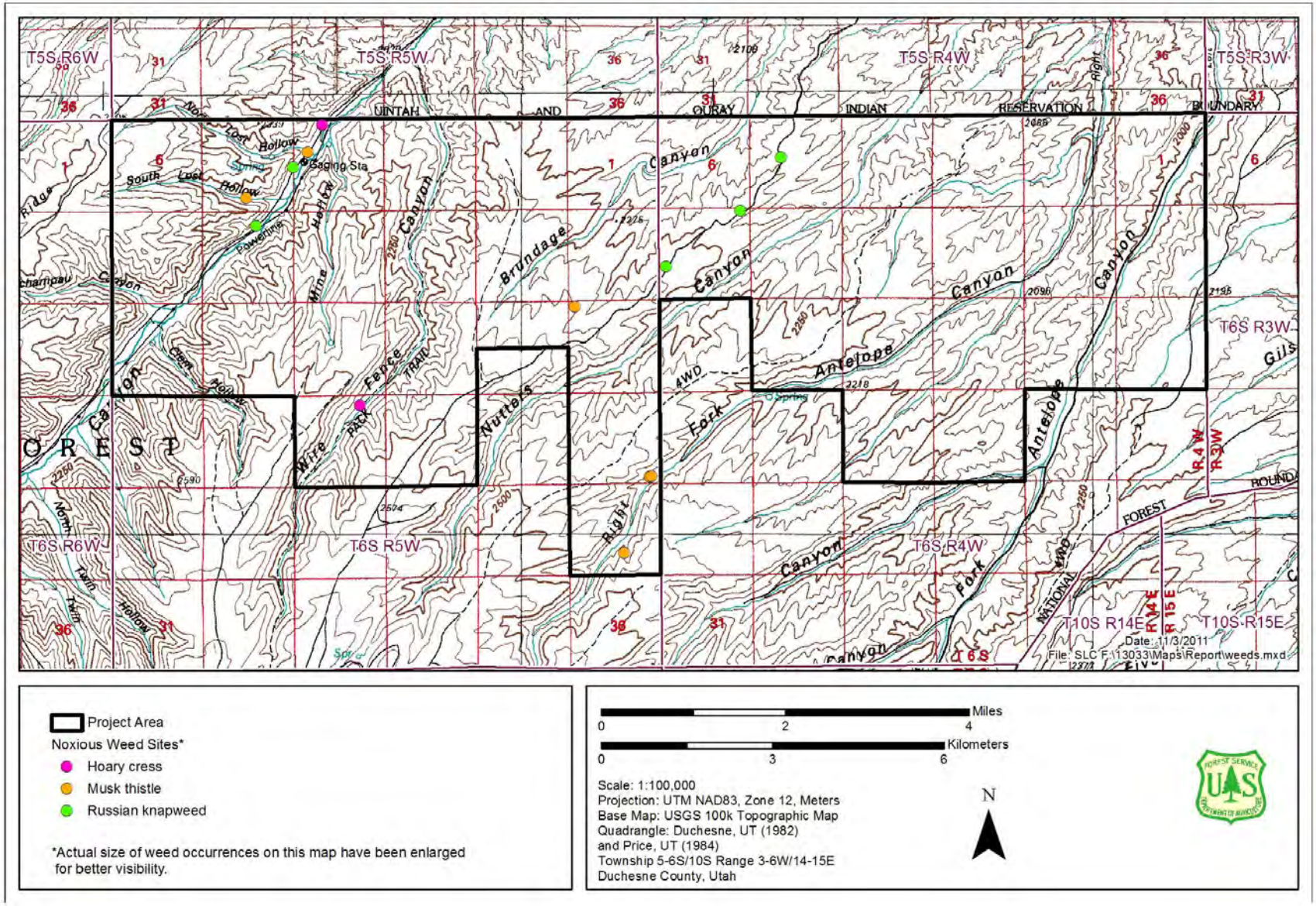


Figure 3-16. Noxious Weed Locations in the Project Area.

Table 3-28. Noxious Weeds Known to Occur in the Project Area, 2007.

Common Name	Scientific Name	Utah Noxious Weed List	Duchesne County Noxious Weed List
Whitetop	*Cardia draba*	X	X
Russian knapweed	*Acroptilon repens*	X	X
Musk thistle	*Carduus nutans*	X	X

Sources: Utah Weed Control Association 2007; Duchesne County Public Works Weed Department 2007.

Table 3-29. ANF Sensitive Plant Species Evaluated for the Project Area, 2008.

Common Name	Scientific Name	Habitat	Potential Occurrence in Project Area
Narrow moonwort	*Botrychium lineare*	1,500–3,000 meters (m) in mountains, meadows, woods, and woodlands, upland sections of river valleys. May colonize early seral habitats (U.S. Fish and Wildlife Service 2003).	No
Clustered lady slipper	*Cypripedium fasciculatum*	Occurs at elevations around 2,700 m in the thick duff of lodgepole pine (*Pinus contorta*) forest understory (Franklin 1990).	No
Untermann daisy	*Erigeron untermannii*	Occurs at elevations ranging from 2,073–2,890 m and is confined to main ridgetops and secondary ridges in the rough canyon and ridge topography south of Duchesne (Franklin 1989).	Yes
Goodrich's blazingstar	*Mentzelia goodrichii*	Endemic in Duchesne County where restricted to steep slopes on Green River shale at 2,470–2,685 m, mostly southern exposures (Welsh 1993).	Yes
Stemless beardtongue	*Penstemon acaulis* var. *acaulis*	Semibarren substrates in pinyon-juniper and sagebrush-grass communities, at 1,790–2,505 m (Franklin 1992).	No
Green River greenthread	*Thelesperma caespitosum*	White shales of the Green River Formation at about 1,920 m with pinyon and mountain mahogany (Welsh et al. 2003).	Possible

There are no known occurrences of Green River greenthread within the Project Area; however, suitable habitat for this species may occur within the Pinyon-Juniper Woodland vegetation type.

3.8.2 Environmental Consequences

Impacts to vegetation and wetland resources are assumed to be proportional to the amount of new surface disturbance (i.e., increased surface disturbance would result in a corresponding increase to vegetation impacts). Impacts to plant communities (including

wetlands) could lead to a reduction in vegetation productivity, a change in species composition, or an increase in invasive non-native species (including noxious weeds).

3.8.2.1 Impacts Common to All Alternatives

Development in the Project Area would require clearing vegetation during the construction phase. Impacts associated with the removal of vegetation include loss of wildlife habitat, a reduction in vegetation diversity, potential for increased soil erosion, potential invasion of noxious and/or nonnative plant species, and loss of livestock forage. Because it would take many years for reclaimed areas to develop the structure and function of self-sustaining vegetation communities (i.e., sagebrush and pinyon-juniper), impacts would persist for an undetermined number of years following reclamation. Reclaimed areas would produce less forage for several years until revegetation is considered successful, at which time grasses and possibly forbs would likely become more dominant than under existing conditions, providing increased forage for some wildlife and livestock. Shrubs and junipers may take 30 to 100 years or longer to reach pre-disturbance productivity levels and wildlife habitat complexity (Braun 1998; Slater 2003). The estimated area of disturbance for each of the vegetation types is provided in Table 3-30. No uncommon or unique vegetation types would be impacted by the project.

Indirect impacts to vegetation include adverse effects from invasion of undesirable plant species (non-native and/or noxious), and from fugitive dust, which could lead to decreased productivity in plant communities. Invasive and noxious weed species can be introduced and become established in areas disturbed by construction, vehicle traffic, road maintenance, and topsoil removal, and are commonly found on newly disturbed and reclaimed sites.

3.8.2.2 Direct and Indirect Impacts

Alternative 1 – No Action Alternative

Under the No Action Alternative, no additional impacts to vegetation other than those previously approved for the Project Area would occur. There would be no additional impacts to vegetation from noxious weeds and invasive species within the Project Area. However, the No Action Alternative may allow present populations of weeds to persist or increase as no additional weed monitoring or management efforts would occur.

Alternative 2 – Proposed Action

The most impacted vegetation community during the drilling and completion phase under the Proposed Action would be the pinyon-juniper woodland community, with a disturbance of 1,009 acres. Because of the large area covered by pinyon-juniper woodland in the Project Area (21,284 acres), about 5% of the community would be impacted by new disturbance. After reclamation, 2% of the pinyon-juniper community would have long-term impacts from surface disturbance in the Project Area.

The Proposed Action would increase the potential for introduction of noxious/invasive plants. Establishment of noxious weeds often leads to displacement of native species and shifts in plant community composition and ecosystem functioning. The resulting changes in the plant community can alter wildlife habitat, wildlife and livestock forage, and the fire regime. Additionally, sites dominated by weeds often have a different visual character that may contrast with the surrounding native vegetation. Indirect impacts resulting from weed infestations in the Project Area would include changes in the fire cycle and

Table 3-30. Surface Disturbance in Vegetation Communities (Acres)*.

Disturbance Type	Pinyon-Juniper Woodland	Big Sagebrush Shrubland	Grease-wood	Black Sagebrush	Riparian	Grass-land	Rabbit-brush	Mountain Brush	Unknown
Alternative 1 – No Action Alternative									
Drilling and Completion	0	0	0	0	0	0	0	0	0
After Interim Reclamation	0	0	0	0	0	0	0	0	0
Alternative 2 – Proposed Action									
Drilling and Completion	1,009	151	86	63	15	12	2	2	22
After Interim Reclamation	443	62	35	29	9	6	1	1	8
Alternative 3									
Drilling and Completion (all phases)	961	164	101	70	18	14	2	2	23
After Interim Reclamation	422	67	41	31	10	6	1	1	9
Alternative 4									
Drilling and Completion	573	106	52	65	9	11	2	2	16
After Interim Reclamation	288	48	22	33	7	6	1	1	6

*Aspen forest and coniferous forest are not included in this table as there would be no impacts to these vegetation communities.

*Individual acreages may not add to total due to rounding.

increased economic costs from weed management efforts. The establishment of some invasive and noxious weed species could result in long-term reclamation problems.

Alternative 3

Under this phased development alternative, overall disturbance to vegetation communities would be nearly the same as the Proposed Action; however, impacts would be spatially distributed across the Project Area and temporally distributed over the 5- to 20-year drilling phase. This would reduce impacts to vegetation communities at any one time compared to the Proposed Action as reclamation and weed control would occur immediately following well completion. Successful interim reclamation would replace forage removed from short-term disturbances. Reclamation of short-term disturbance would likely compensate for a portion of the vegetation lost. Table 3-31 displays disturbance to vegetation communities per phase.

Alternative 4

The total short-term surface disturbance under this alternative would be reduced by approximately 40% compared to the Proposed Action and Alternative 3, and distribution of disturbance across vegetation communities is altered (Table 3-31). The collocation of wells on fewer well pads would result in decreased surface disturbance from roads in the Project Area. The number of access roads and gathering pipelines would be reduced compared to the Proposed Action, which would also reduce the potential for introduction of noxious and invasive weeds along roadsides and would reduce indirect adverse impacts from fugitive dust on vegetation.

3.8.3 Mitigation

No off-road driving would be allowed. All project vehicles would remain restricted to the ROW corridors, well pads, and approved temporary access roads. Signs would be used to identify approved and restricted (i.e., no public access allowed) roads. Fire prevention and suppression techniques would be implemented to reduce the potential for a construction-related fire that could potentially impact vegetation and wildlife.

For all locations and access roads, the Operator would promptly revegetate all disturbed areas not necessary for production with a Forest Service-approved seed mixture. Revegetation would commence immediately after construction. Reclamation achievement would be evaluated using the standards described in the Reclamation Plan (Appendix B). Rehabilitation efforts must be repeated if it is concluded that the success rate is below an acceptable level as determined by the Forest Service.

The Operator would be required to water or surface access roads to reduce airborne dust and damage to roadside vegetation communities.

The Operator would conduct all surface activities in accordance with the LRMP (Forest Service 1986). In addition to the mitigation measures included in the Proposed Action, the following mitigation measures are recommended to minimize impacts from noxious, non-native, and invasive plant species.

- Conduct pre-construction surveys in the spring for weed infestations within the site boundaries and along access roads.
- Consult Duchesne County Weeds Department to determine treatment for noxious weeds, if identified.

Table 3-31. Impacts to Vegetation Communities for Alternative 3 by Phase.*

Disturbance Type	Pinyon-Juniper Woodland	Big Sagebrush Shrubland	Grease-wood	Black Sagebrush	Riparian	Grass-land	Rabbit-brush	Mountain Brush	Unknown
Phase 1									
Drilling and Completion	163	75	43	0	0	0	0	0	0
After Interim Reclamation	76	27	14	0	0	0	0	0	0
Phase 2									
Drilling and Completion	244	23	25	0	0	0	0	0	0
After Interim Reclamation	100	10	12	0	0	0	0	0	0
Phase 3									
Drilling and Completion	213	29	0	1	0	0	0	0	17
After Interim Reclamation	88	14	0	0	0	0	0	0	9
Phase 4									
Drilling and Completion	149	11	6	10	0	0	0	0	0
After Interim Reclamation	71	3	2	3	0	0	0	0	0
Phase 5									
Drilling and Completion	155	13	15	26	16	14	2	2	6
After Interim Reclamation	71	6	7	13	9	6	1	1	0
Mule Deer Crucial Summer									
Drilling and Completion	6	14	0	33	0	0	0	0	0
After Interim Reclamation	3	6	0	15	0	0	0	0	0
Mule Deer Crucial Winter									

Disturbance Type	Pinyon-Juniper Woodland	Big Sagebrush Shrubland	Grease-wood	Black Sagebrush	Riparian	Grass-land	Rabbit-brush	Mountain Brush	Unknown
Drilling and Completion	31	0	13	0	2	0	0	0	0
After Interim Reclamation	14	0	6	0	1	0	0	0	0

*Aspen forest and coniferous forest are not included in this table as there would be no impacts to these vegetation communities.

- Construction vehicles and equipment would be cleaned, power-washed, and free of soil and vegetation debris prior to entry and use of access roads to prevent transporting weed seeds.
- All seed mixtures, erosion control materials, and reclamation materials would be certified weed free.
- Revegetated areas would be monitored following seeding to evaluate the need for supplemental seeding and noxious weed control.
- The ROW and other disturbed areas would be monitored for weed infestations, and new or expanding populations would be controlled or eradicated for the duration of the construction, operation, and reclamation phases.
- The presence of designated weeds in the Project Area requires that the Operator develop and implement management measures to prevent the spread of noxious weeds and install a monitoring system.

3.8.4 Cumulative Impacts

Existing activities in this area include historical and ongoing oil and gas development, ranching and grazing, fuel reduction projects, and proposed or reasonably foreseeable future oil and natural gas development. These activities have all contributed to the removal of native vegetation, and an increase in invasive and noxious weed species in the CIAA.

The pinyon-juniper community is the dominant vegetation type in the Project Area and the CIAA, and would experience the greatest amount of disturbance from the Proposed Action or any of the action alternatives. Disturbance from RFAs in the CIAA would cause further loss to this plant community. Due to the widespread distribution of pinyon-juniper community in northeast Utah, a relatively small proportion of this plant community would be impacted. Increased fugitive dust accumulation on vegetation would reduce photosynthetic activity and growth and could result in long-term alteration of species composition, cover, and productivity. If not mitigated, these impacts could create significant impacts to vegetation across the CIAA.

Reclamation and revegetation efforts would be required for all oil and gas and pipeline projects in the CIAA. These efforts typically involve recontouring and planting of perennial grasses. This often results in increased dominance of herbaceous vegetation and a general decrease in the shrub stratum, at least temporarily. Recovery of habitat functionality for shrubs in treatments generally occurs within 20 to 50 years, whereas recovery of shrubs in reclamation tends to take longer. Due to limited annual precipitation and poor soil quality in the CIAA, reclamation success may be difficult to achieve, resulting in long-term impacts to the diversity of native vegetation.

3.8.4.1 Forest Service Sensitive Plant Species

Direct and Indirect Impacts

Alternative 1 – No Action Alternative

Under the No Action Alternative, no additional impacts to threatened, endangered, candidate, and sensitive plant species other than those previously approved for the Project Area would occur.

Alternative 2 – Proposed Action

Two Forest Service sensitive species, Untermann daisy and Goodrich's blazingstar, occur in the vicinity of the Project Area. Suitable habitat for Green River greenthread has been identified in the Project Area; however, no occurrences have been documented. Occurrences of Untermann daisy are located in the northwest corner of the Project Area in the Mine Hollow and South Lost Hollow areas (Goodrich 2010). Pre-construction surveys for Untermann daisy in the northwestern portion of the Project Area would identify the presence of these species, and any found populations would be avoided. Numerous inventories have been conducted in the eastern three quarters of the Project Area and no plants have been found, therefore no additional surveys would be required in this area. No direct impacts to these species would be anticipated as a result of implementation of the Proposed Action. The potential loss of suitable habitat that has not been identified resulting from construction activities could prevent recruitment and colonization of new populations in those areas. Fugitive dust from vehicles and noxious weed invasions are potential indirect impacts. Noxious weeds that out-compete native species have the potential to eliminate existing sensitive plant populations and prevent recruitment. Fugitive dust could collect on photosynthetic surfaces, and lead to reduced plant vigor, growth, and reproductive success.

Alternative 3

Impacts from Alternative 3 would be the same as those for the Proposed Action.

Alternative 4

Impacts from Alternative 4 would be similar to those for the Proposed Action. The reduction in overall surface disturbance would reduce the potential for habitat loss for sensitive plant species.

3.8.5 Mitigation

The following measures are recommended to protect federally listed and Forest Service sensitive species.

- If any federally listed species or Forest Service sensitive species are observed during pre-construction surveying or project operations, status information should be forwarded to the Forest Service and appropriate avoidance protocol implemented. Operations that would adversely affect the listed species must be discontinued until consultation with the Forest Service indicates that impacts are not likely to adversely affect the species.
- If federally listed or Forest Service sensitive plants are discovered during field surveys, these individuals or populations would be avoided during final project design.
- Documented populations of sensitive plant species would be avoided.

3.8.6 Cumulative Impacts

Cumulative impacts to threatened endangered, candidate, or sensitive plant species include potential loss of suitable habitat and indirect impacts from fugitive dust and noxious weed invasion throughout the CIAA.

3.9 Wildlife

3.9.1 Affected Environment

This section describes the occurrence and distribution of threatened, endangered, MIS, sensitive terrestrial and aquatic species, and migratory birds within the Project Area. Wildlife habitat and distribution data were obtained from existing resource data for the ANF, state resource agencies, and other studies. Relevant scientific literature and wildlife management reports were used as a basis for describing species ecology, habitat needs, distribution, and management guidelines.

The following subsections provide a brief overview of federally listed species under the ESA, Forest Service Region 4 Sensitive Species, and ANF MIS that may occur within the Project Area. More detailed information is provided in the Biological Assessment (federally listed species), Biological Evaluation (Forest Service Region 4 Sensitive Species), and MIS Report prepared for this project.

3.9.1.1 Federally Listed Species

Under the ESA, the USFWS lists threatened, endangered, or candidate animal species that are known or suspected to occur or have habitat in Duchesne County. This section will only discuss those species that are listed as threatened or endangered. Three species are candidate species for federal listing, but are not yet listed as T&E under ESA. These species are the sage grouse, yellow-billed cuckoo, and wolverine and were all evaluated in the Biological Evaluation. Refer to the Biological Evaluation for further information on these species. Additionally, sage grouse will be discussed in the Sensitive Species section of this document. Table 3-32 below lists those threatened or endangered species that are known or suspected to occur or have habitat in Duchesne County. No threatened or endangered wildlife species are expected to occur in the Project Area due to lack of suitable habitat. Detailed information on threatened and endangered species is provided in the Biological Assessment; brief summaries are provided below.

In Utah, an experimental population of black-footed ferret was established in Uintah County on lands managed by the BLM southeast of Vernal. This species does not presently occur anywhere else in Utah. The only areas of suitable habitat within the ANF exist on the Flaming Gorge National Recreation Area. This species is not expected to occur in the Project Area due to the lack of suitable habitat and absence of prairie dog towns within or adjacent to the Project Area.

Lynx habitat occurs in the western portion of the South Unit of the ANF and lynx have been documented approximately 15 miles west of the Project Area in Indian Canyon (Shenk 2007). However, because of the lack of connectivity of only marginal lynx habitat, this area has not been designated as a Lynx Analysis Unit (Forest Service 2006c). Therefore, this habitat to the west of the Project Area may serve as a linkage corridor for lynx moving from one geographic area to another. However, the eastern portion of the South Unit, in which the Project Area lies, contains no lynx habitat. Based on habitat maps and distribution (USDA 2007; Ruediger et al. 2000), lack of primary and secondary prey, and absence of large stands of coniferous forests, lynx are not expected to occur in the Project Area.

Table 3-32. Federally Endangered and Threatened Species for Duchesne County, Utah.

Species (Scientific Name)	Status[1]	Habitat in Utah	Potentially Affected?
Mammals			
Black-footed ferret (*Mustela nigripes*)	E	Large prairie dog complexes	No
Canada lynx (*Lynx canadensis*)	T	Mid- to high-elevation coniferous or mixed-conifer forests	No
Birds			
Mexican spotted owl (*Strix occidentalis lucida*)	T	Steep-walled canyons with pockets of mixed-conifer, pine-oak, pinyon-juniper, or riparian vegetation	No
Fishes			
Humpback chub (*Gila cypha*)	E	Colorado River Basin	Yes
Bonytail (*Gila elegans*)	E	Colorado River Basin	Yes
Colorado pikeminnow (*Ptychocheilus lucius*)	E	Colorado River Basin	Yes
Razorback sucker (*Xyrauchen texanus*)	E	Colorado River Basin	Yes

[1] Status: T = Threatened; E = Endangered; C = Candidate

Source: USFWS 2010

Although habitat models predict suitable Mexican spotted owl habitat within the ANF (1997 model: entire South Unit; 2000 model: smaller portion of the South Unit), particularly in the Vernal and Flaming Gorge districts, there have been no detections of the Mexican spotted owl within the ANF (Forest Service 2006c). Suitable habitat may exist in the Stream Canyon and possibly Glacial Canyon LTs. Suitable habitat does occur south of the Project Area in southern Duchesne County, including Nine-Mile and Argyle canyons (USFWS 2007); however, ground-truthing surveys conducted by Forest Service biologists in 2004 determined that suitable Mexican spotted owl habitat does not exist within the Project Area (Forest Service 2004a). This report determined that although some side canyons do meet the ~~2~~ x 2" rule (a canyon that is less than 2 km wide and greater

than 2 km long), they do not contain sufficient cliff habitat (i.e., steeped-walled canyons) or breeding habitat. As such, this species is not expected to occur in the Project Area.

Bonytail, Colorado pikeminnow, humpback chub, and razorback sucker are endemic fish species that once thrived in the Colorado River system. Dam installation and the introduction of non-native fish changed the river environment and put these fish at risk (USFWS 2006). According to the USFWS (2007), there is designated critical habitat in Duchesne County for all four fish species, and ~~w~~water depletions from any portion of the occupied drainage basin are considered to adversely affect or adversely modify the critical habitat of the endangered fish species, and must be evaluated with regard to the criteria described in the pertinent fish recovery goals.

3.9.1.2 Forest Service Sensitive Wildlife Species

The ANF list of Sensitive Species was adopted from the Forest Service Regional Forester Sensitive Species List. The species on this list that are known or suspected to occur in the ANF are summarized in Table 3-33.

Table 3-33. Forest Service Sensitive Species that Occur or May Be Influenced by Management Actions in the ANF.

Species (Scientific Name)	Habitat in ANF[1]	Potentially Affected[2]
Mammals		
Spotted bat (*Euderma maculatum*)	Various habitats and elevations, but most often in dry, rough desert terrain. Have been located in the South Unit near the Project Area (Alkali Canyon) in pinyon/juniper/sage at 7,400 feet. Utah elevational range is 2,700–9,200 feet.	Yes
Townsend's big-eared bat (*Plecotus townsendii*)	Various habitats and elevations, but primarily found in shrub steppe and pinyon/juniper habitats. Limestone Hills, Limestone Plateau, and various canyon land type associations contain most of the suitable habitat in the ANF. Utah elevational range is 3,300–8,851 feet.	Yes
Pygmy rabbit (*Brachylagus idahoensis*)	Sagebrush habitats interspersed with grasses and forbs. Documented north of Flaming Gorge Reservoir and the western portion of Utah.	No
Wolverine (*Gulo gulo*)	Tundra, boreal forests, and coniferous forests. Large, sparsely inhabited areas in high elevation, remote portions of mountain ranges. Uinta Mountains, especially the High Uinta Wilderness, appear to contain suitable habitat.	No
Bighorn sheep (*Ovis canadensis*)	Steep, rocky slopes in rugged mountainous areas	No

Species (Scientific Name)	Habitat in ANF[1]	Potentially Affected[2]
Birds		
Yellow-billed Cuckoo *Coccyzus americanus occidentalis*	Nests in lowland riparian associated with large tracts of cottonwood stands with dense understory. There are no records of occurrence on the Ashley.	No
Trumpeter swan (*Cygnus buccinators*)	Seen on the Flaming Gorge Reservoir. Prefers ice-free waters with slow currents, little human disturbance, and limited trees or shrubs.	No
Common loon (*Gavia immer*)	Extensive lacustrine habitats. Seen on Flaming Gorge Reservoir during migration.	No
Bald eagle (*Haliaeetus leucocephalus*)	Usually occurs near Flaming Gorge Reservoir and Green River corridor during winter. Closely associated with areas near water.	No
Peregrine falcon (*Falco peregrinus*)	Known to nest on cliffs along Flaming Gorge Reservoir. Usually found where rivers, marshes, or other wet habitats are associated with cliffs.	No
Flammulated owl (*Otus flammeolus*)	Ponderosa pine or Douglas-fir forests, occasionally mixed with mature aspen.	Yes
Northern goshawk (*Accipiter gentilis*)	Uses a wide variety of forest types in the ANF, but majority of known breeding territories are in lodgepole or mixed conifer stands. Stands with large trees and relatively open understories are preferred for foraging.	Yes
Boreal owl (*Aegolius funereus*)	Spruce/fir or mixed conifer (Engelmann spruce, subalpine fir, and lodgepole pine) forests. May use aspen if suitable conifer habitat nearby.	No
Great gray owl (*Strix nebulosa*)	Conifer or conifer/hardwood forests. Uinta Mountains are at or just beyond the southern limit of normal range and species is considered casual or irregular in Utah.	No
American three-toed woodpecker (*Picoides dorsalis*)	Coniferous forests, sometimes mixed with aspen. Has been found in lodgepole, Douglas-fir, spruce/fir, and mixed conifer in the ANF.	Yes
Mountain plover (*Charadrius montanus*)	Shortgrass prairie, sparsely-vegetated sagebrush communities, and shrub-steppe habitat, often in association with prairie dog colonies	No
Greater sage-grouse (*Centrocercus urophasianus*)	Sage-grouse populations are allied closely with sagebrush habitats. Optimum habitat is dominated by big sagebrush containing a good understory of grasses and forbs and in close proximity to wet meadow areas and aspen.	Yes

Species (Scientific Name)	Habitat in ANF[1]	Potentially Affected[2]
Fishes		
Colorado River cutthroat trout (*Oncorhynchus clarki pleuriticus*)	Cool, clear water of high-elevation lakes and streams containing well-distributed pools, natural flows, adequate cover, and stable stream banks.	No
Amphibians		
Boreal toad (*Bufo boreas boreas)*	Relatively high elevation habitats including slow moving streams, wetlands, desert springs, ponds, lakes, meadows and woodlands.	No No
Columbia spotted frog (*Rana luteventris)*	Semipermanant ponds with cool, clear spring-fed water and organic substrates including small springs, ponds or sloughs with a variety of herbaceous emergent, floating, and submergent vegetation	No No No

[1] Habitat relationships obtained from Forest Service 2006c.

[2] Species not potentially affected are not described further in Chapter 3, but are described in the Biological Evaluation.

Sensitive species of wildlife and fish selected for analysis based on their habitat and known occurrence in the Project Area include spotted bat, Townsend‘s big-eared bat, flammulated owl, northern goshawk, American three-toed woodpecker, and greater sage-grouse. A brief summary for each of these species is provided below. Additional information on these species and species not selected for analysis, including suitable habitat and any known occurrences, is provided in the Biological Evaluation in the project record.

Spotted bat

Spotted bats occur throughout Utah in various habitats and elevations, including pinyon/juniper and scrub country (Luce and Keinath 2007). They are often associated with riparian and springs that occur in these drier habitats, likely because of the water loss for respiratory demands during flight (Luce and Keinath 2007). Therefore, water sources may be a limiting factor in arid environments (Luce and Keinath 2007). Roost sites include loose rocks or crevices in rock cliffs, and hibernacula usually occur in caves (Luce and Keinath 2007). They have been located in the South Unit of the ANF in pinyon/juniper and sage habitat at 7,400 feet (Perkins 2002). Subsequent surveys in 2007 and 2008 at Alkali Canyon have not detected spotted bats (Christensen 2011b). The proximity of these survey locations to the Project Area, combined with the spotted bat capture locations occurring in pinyon/juniper and sage habitat, indicates that suitable habitat for this species exists within the Project Area.

Townsend's Big-eared Bat

Townsend‘s big-eared bats use a variety of habitats, but almost always occur near caves or cave-like roosting areas in mesic habitats characterized by coniferous and deciduous forests (Kunz and Martin 1982). In Utah they are primarily found in shrub steppe and pinyon/juniper habitats at 3,300 to 8,851 feet (NatureServe 2007, Gruver and Keinath 2006), but can occur in many types of habitat, particularly forested areas (UDWR 2007). Caves, mines, and buildings are used for day roosting and winter hibernation (UDWR 2007, Gruver and Keinath 2006). Surveys were conducted in 2007 and 2008 in riparian habitat as well as four caves in the ANF. This bat was not detected at the riparian sites, but was found in three of the caves during surveys (Christensen 2011b). This bat has not been found on the South Unit of the Forest where the project resides (Christensen 2011b). This is likely because there are no known caves in the area of the project area. Although these bats have not been observed in the South Unit, due to the presence of coniferous and deciduous forests, pinyon/juniper habitat, and the canyons that proliferate this area, suitable habitat may occur in the Project Area.

Flammulated Owl

The flammulated owl inhabits old-growth or mature ponderosa pine (*Pinus ponderosa*) and ponderosa-Douglas-fir forests, often mixed with mature aspen (Reynolds and Linkhart 1992; Richmond et al. 1980). Owls are sometimes associated with pure aspen stands in some areas (Webb 1982) and flammulated owls have been documented to successfully breed in aspen-dominated forests (Oleyar 2000). Owl surveys from 1992 to 2005 in the ANF detected 30 flammulated owls in coniferous forests (ponderosa pine) and aspen-dominated forests, as well as aspen/ponderosa pine stringers in sagebrush-dominated communities (Forest Service 2006c). In 2010, Hawk Watch International recorded 33 flammulated owl detections in the Roosevelt/Duchesne district of the ANF, including the South Unit, but not within the project (Christensen 2011b). Habitat is located in the southern and western portions of the Project Area, at the top of Nutters and Wire fence ridges, which contain small stands of aspen and Douglas-firSurveys in the Project Area in 2007 did not detect flammulated owl (SWCA Environmental Consultants [SWCA] 2007).

Northern Goshawk

Northern goshawks use a wide variety of forest types in the ANF, but the majority of the known breeding territory is in lodgepole or mixed conifer stands and aspen. The habitat within and surrounding the proposed Project Area does provide some nesting habitat for goshawks, although nesting habitat areas are small and relatively isolated and surrounded by drier, less favorable landscapes.

There are no known territories in the Project Area and habitat is limited. There is a goshawk territory that is over 8 miles from the proposed Project Area (Territory #402: Sowers Canyon Goshawk Territory [SOW]) (Forest Service 2007d, 2007e). Four nests have been observed within this area (Sowers Canyon A, B, C, D), all of which have been inactive since 2000 or earlier (Forest Service 2007d; Dalton 2011). The Sowers Canyon A nest, located in a Douglas-fir tree, fledged at least one goshawk in 1999 and 2000, but is now completely fallen and the nest tree is dead. Northern goshawks were observed during field investigations in July 2007, and a possible nest (inactive) was reported in a Douglas-fir tree outside of the Project Area in an area where more favorable nesting habitat exists (SWCA 2007); due to the small size of the Douglas-fir stand and surrounding habitat it was determined after subsequent review that the nest was not a goshawk nest. During the summer of 2010, four additional nests were found within this territory (Forest Service

2010). One nest was determined to be active but subsequently failed after the nest tree fell (two broken goshawk eggs were observed in the fallen nest). The Sowers Canyon goshawk territory was monitored in 2011 and no goshawks were detected in the area (Dalton 2011).

Suitable habitat also occurs in aspen forest on Nutters Ridge and Wire Fence Ridge, and goshawk sightings have been reported there. The Forest Service conducted calling surveys in habitat south of the Project Area in 2006–2008 and 2010, and no goshawks or nests were detected (Christensen 2011b).

The ANF has been annually monitoring northern goshawks since 1991. Occupancy has fluctuated since the data collection began; however, based on statistical analysis, the goshawk population trend across the forest appears to be stable. It also appears that the ANF supports a viable goshawk population and continues to provide well-distributed habitat across the forest for this species (Forest Service 2006c, 2006d, 2007d, 2010; Christensen 2011b) more information available in the MIS Specialist Report and the Biological Evaluation available in the project record.

American Three-toed Woodpecker

American three-toed woodpeckers are permanent residents that breed in woodland areas, including Engelmann spruce (*Picea engelmanii*), sub-alpine fir (*Abies lasiocarpa*), Douglas-fir, ponderosa pine, aspen, and lodgepole pine forests (UDWR 2007). Surveys for this species have been conducted through 2010 (Christensen 2011b). American three-toed woodpeckers are widely distributed across the ANF, where they have been found in lodgepole pine, Douglas fir, spruce/fir, and mixed conifer forests. Habitat for this species occurs in Douglas-fir forests (310 acres of coniferous forest) occupying the southwestern portion of the Project Area (Figure 3-15).

Greater Sage Grouse

The greater sage-grouse occupies sagebrush plains, foothills, and mountain valleys across Utah, and optimum habitat is dominated by big sagebrush containing a good understory of grasses and forbs and in close proximity to wet meadow areas and aspen (UDWR 2007). The current distribution of the greater sage-grouse is estimated at 56% of its potential pre-settlement distribution, and includes southern Idaho, Montana, southern portions of Alberta and Saskatchewan, southwestern North Dakota, and western South Dakota south to east-central California, south-central Nevada, southern Utah, and northwestern Colorado; a separate, distinct population occurs in the Columbia Basin of central Washington (NatureServe 2007). It is presumed extirpated in southern British Columbia, western Nebraska, Oklahoma, New Mexico, and northern Arizona (USFWS 2010; NatureServe 2007).

During winter, sage-grouse feed primarily on sagebrush leaves. Their diet includes the fruiting heads of sagebrush, leaves and flower heads of clovers (Trifolio spp.), dandelions (Taraxacum officinale), and grasses (UDWR 2007). Insects are also eaten, and are particularly an important food item for newly hatched broods.

During winter, males and females congregate in separate flocks. During March and April, male sage-grouse gather on traditional strutting grounds, or leks, and perform courtship activities that include strutting with tails erect and spread, and air sacs inflated. Between 2002 and 2006, greater sage-grouse in the area within and surrounding the Project Area were observed strutting as early as March 13 and as late as May 23; peak strutting has been observed as early as the third week of April and as late as May 17 (Forest Service

2007a). Lek areas are often selected based on the quality of adjacent nesting and brood-rearing habitat; however, males may form leks opportunistically within potential nesting habitat where female traffic is high (Wakkinen et al. 1992; Schroeder et al. 1999; Connelly et al. 2000). Leks consist of open sites surrounded by sagebrush or may be located in clearings or disturbed areas where sagebrush density is low, such as exposed ridges, knolls, or grassy swales (Schroeder et al. 1999). Females arrive to the strutting grounds in March or early April. Most of the mating is conducted by a few of the dominant cocks and nesting begins in April or May. In 2006, six of the eight collared greater sage-grouse hens within the immediate vicinity of the Project Area initiated nesting as early as May 11; nests in this five-year study have been initiated as early as May 1 (Forest Service 2007a).

Nests consist of a shallow depression lined with grass or twigs and are usually located in thick sagebrush habitat, usually beneath individual sagebrush or other shrub. The nest site is often associated with areas dominated by sagebrush, and occurs in areas with taller sagebrush, greater shrub canopy cover, and more ground litter (Musil et al. 1994). Grasses and other shrubs may be used for nesting. Between 2002 and 2006, greater sage-grouse nesting habitat within the immediate vicinity of the Project Area averaged 34% litter cover, 20% sagebrush cover, 19% grass cover, 6% forb cover, and 2% other shrub cover; successful nesting habitat averaged 35% litter cover, 22% grass cover, and 17% sagebrush cover (Forest Service 2007a). Five to nine eggs are laid and incubate after 25 days. Greater sage-grouse nests within the immediate vicinity of the Project Area contained an average of 7.1 eggs per nest and eggs were observed to be hatched as late as June 16 (Forest Service 2007a). Of the six nests initiated in 2006, four were successful and resulted in an average of 7.25 (94%) eggs per nest that hatched (average of 7.25 chicks in a brood per hen) (Forest Service 2007a).

During brood-rearing, hens use sagebrush uplands adjacent to nest sites that provide a sagebrush overstory, herbaceous understory, and abundant insects for foraging. This early-spring habitat for brood-rearing is critical to brood survival. In 2006, early brood-rearing habitat for greater sage-grouse within the immediate vicinity of the Project Area averaged 26% sagebrush cover (41 centimeters [cm] high), 3% other shrub cover (20 cm high), 23% grass cover (18 cm high), 15% forb cover (11 cm high), 16% litter, 7% soil, and 10% rock (Forest Service 2007a). Hens move their broods to wetter sites in June and July, as the spring habitats dry (Connelly et al. 2000). These habitats are highly variable, and may include wet meadows and agricultural fields; they are always food-rich areas that provide forbs and insects. In 2006, brood-rearing habitat for greater sage-grouse within the immediate vicinity of the Project Area was often found near the edge (within 20 meters [m]) of two plant community types. Brood-rearing habitat averaged 22% sagebrush cover (32 cm high), 4% other shrub cover (17 cm high), 25% grass cover (14 cm high), 11% forb cover (10 cm high), 27% litter, 10% soil, and 1% rock (Forest Service 2007a).

Greater sage-grouse are well-adapted to extreme winter conditions, but their survival is dependent on access to sagebrush for food and cover. They use a landscape mosaic that contains a diversity of sagebrush canopy cover and heights. Their selection of winter sites is influenced by both topography and the availability of sagebrush above the snow; sage-grouse often move to taller sagebrush habitats as lower-statured plants become snow covered. They are known to move considerable distances to find good habitat, and winter ranges may exceed 140 square kilometers (km2) (Robertson 1991). Greater sage-grouse within the immediate vicinity of the Project Area migrate to three different lower elevational locations and have been documented traveling as far as 16 miles north of the

Anthro Mountain study area to Lower Cottonwood Ridge, just north of the Project Area; several grouse made multiple movements between these two areas (Forest Service 2007a). Movements of over 20 miles have also been documented in this population (two grouse in 2002 and one in 2003 to the Emma/Whitmore Park area 15 to 20 miles south of Anthro Mountain; one male was documented strutting on a lower elevational lek 26 miles to the southwest of Anthro Mountain) (Forest Service 2007a). Results of an ongoing translocation study indicate two additional wintering areas to the east (Big Wash/Sand Wash) and north (Blue Bench) of the Project Area (Christensen 2011b), the latter location showing evidence of birds mingling with individuals from other populations that use the Blue Bench area for wintering.

Status within Project Area: In 2002, the ANF, in conjunction with the UDWR, initiated a long-term radio telemetry sage-grouse study to 1) gather information (population, habitat, and migration data) on the Anthro Mountain sage-grouse population prior to intensive oil and gas exploration and/or development, and 2) assess the habitat requirements and status and trends of the sage-grouse population. In total, 95 adult/juvenile sage-grouse and 47 chicks were captured and fitted with radio transmitters over the course of the study (2002–2008) (Forest Service 2007a; Christensen 2011b). During this time over 1,700 locations were recorded; Figures 2 and 3 depict telemetry locations of radio-tagged sage-grouse for all seasons between 2002 and 2008 and winter 2002 through 2008. From these locations, a sage-grouse habitat map was developed. Preliminary telemetry data from these collared birds have shown some individuals traveling over 30 km; other individuals are sedentary but show seasonal elevational movements (Forest Service 2007a). Preliminary results also indicate that sage-grouse habitat use may favor sagebrush islands associated with 20% to 30% canopy cover and a matrix of grass/forb vegetative components for brood rearing and summer habitat (Forest Service 2006a). These matrices often occur in association with an environment where fire is not excluded. Sage-grouse also appear to use aspen communities during mid to late summer, which provide a cooler, moister microclimate (Forest Service 2006a). During migration, these Anthro birds are suspected to use openings (chained areas) within pinyon/juniper that are in route to wintering areas, and these openings in the pinyon/juniper belt may be of importance during migration events to and from wintering areas.

More recent research efforts between 2008 to present include a translocation of 60 hens from southern Utah (Parker Mountain) to Anthro Mountain to augment the Anthro population. Investigations into resident and translocated hen survival rate, nest success, and habitat selection are also being conducted. Transmitters were placed on chicks from resident and translocated hens to evaluate survival rates. Blood samples were collected from resident Anthro Mountain sage-grouse in 2008 to determine relatedness to other sage-grouse populations. The Anthro Mountain population appears to be most closely related to the Strawberry Valley population to the west.

There are no active sage-grouse leks within the Project Area; one lek is immediately adjacent to and three leks are within 4 miles of the Project Area (Figure 4) (Forest Service 2007a). These leks are part of the Anthro Mountain population. The lek immediately adjacent to the Project Area is located on a ridgeline between Wire Fence Canyon and Nutters Canyon; another is located along this same ridgeline approximately 1.6 miles southwest. The next closest lek is west of the two aforementioned leks on a ridgeline between Wire Fence Canyon and Sowers Canyon, approximately 0.65 mile from the Project Area. The number of males counted at each of the four leks during spring 2006

surveys ranged from 4 to 24 individuals. Total counts for all four leks include 44 males in attendance in 2006, 41 males in 2007, 16 males in 2008, 7 males in 2009, and 4 males in 2010; the decrease in male lek attendance in 2008 is believed to be a combination of a hard winter, higher predation rate, and breeding occurring at locations where snow pack had receded earlier than other locations (Anthro leks were free of snow pack 4 weeks later than normal and many birds were believed to have bred at lower elevations) (Christensen 2008).

Lek count results may also be influenced by males attending additional leks that were not counted and males remaining at distances removed from leks so as not to be counted, as documented by telemetry data (Christensen 2011b). In 2011, there were no males counted at any of the four (traditional) leks but 8 males and nine females were observed on a new well pad (capped and not in production) on Jeep Trail Ridge (Duvuvuei and Messmer 2011). The area within the 4-mile lek buffer contains nesting habitat and Walker et al. (2007) found that lek persistence was positively influenced by the proportion of sagebrush habitat within 4 miles of the lek. Total sage-grouse habitat within 4 miles of leks occurring on Anthro Mountain is 20,460 acres; 2,102 acres of this sage-grouse habitat are within the Project Area (Figure 4). Radio telemetry data indicate that sage-grouse nesting habitat, brooding habitat, and winter habitat are all co-located within these 20,460 acres including the 2,102 acres located in the Project Area (Figures 2 and 3). These 2,102 acres occur in the southern and western portions of the Project Area, and include the upper portions of Sowers, Mine Hollow, Wire Fence, Brundage, Nutters, and Right Fork Antelope canyons.

Density and Disturbance Analysis: To evaluate existing disturbance within sage-grouse habitat within and around the Project Area, a Density Disturbance Calculation Tool (DDCT) was established. This process has been initiated by the Bureau of Land Management (BLM) in the state of Wyoming (BLM IM WY-2010-12) as part of the Governor‘s Greater Sage-Grouse Core Area Protection Executive Order 2011-5. The policies aim to evaluate project actions within the context of maximum allowable disturbance of suitable sage-grouse habitat within an area affected by a project. Although the state of Utah does not have a process to evaluate these impacts, the DDCT was used for the project to determine existing and allowable levels of disturbance within sage-grouse habitat within the project analysis area (total disturbed acres should stay under 5% of the DDCT area). According to BLM IM WY-2010-12, a sage-grouse habitat evaluation should extend out 11 miles from the project boundary for large-scale proposed actions. Evaluation of the area within the 11-mile radius from the project boundary in large projects is required to encompass the majority of seasonal habitats that may be affected (Connelly et al. 2000).

To determine the extent of existing and allowable disturbance within the DDCT area, the following steps were conducted:

1. An 11-mile buffer was placed around the Project Area. All occupied leks located within this boundary were considered to be affected by the project.
2. A 4-mile buffer was placed around each lek considered affected by the project (creating the DDCT analysis area).
3. A sage-grouse habitat assessment was conducted for the area within the 4-mile boundary of the affected leks. Lands within these lek buffers were categorized as suitable or unsuitable sage-grouse habitat. This habitat assessment was based on over 1,700 sage-grouse telemetry locations and associated habitat.

4. The total existing disturbance acres in suitable sage-grouse habitat within the 4-mile lek buffers were calculated. Existing disturbance included Forest Service system roads and well pads, as these were the only anthropogenic disturbances that were identified to occur within the DDCT area.
5. A determination of existing and allowable suitable habitat disturbance was made. The total number of existing disturbance acres within suitable habitat was divided by the total acres of suitable habitat within the DDCT area to yield a percent disturbance of sage-grouse habitat within the DDCT area. This percent was subtracted from 5% to yield the new allowable suitable habitat disturbance within the DDCT area. The 5% disturbance is a stipulation implemented by the Wyoming BLM and refers to the maximum surface disturbance within the DDCT per an average of 640 acres. Each alternative was analyzed to determine if the proposed additional disturbance (as measured by the acres of habitat) from well pads and roads would stay under the 5% limit.
6. A determination of the existing and allowable number of anthropogenic disturbances (i.e., well pads and roads) that occur within the DDCT area was made. An average density of one anthropogenic disturbance per square mile within the DDCT area would be allowed. Existing disturbance density was calculated as the number of disturbances (well pads) in suitable sage-grouse habitat or in unsuitable habitat that is less than 0.6 mile from suitable habitat. A disturbance was also counted, if an existing Forest Service system road crossed a 0.6 mile buffer of a lek. If the road forked within the buffer, it was only counted as one disturbance. Each alternative was analyzed to determine if the proposed additional disturbance (as measured by the number of new roads within 0.6 mile of a lek or well pads in suitable sage-grouse habitat or in unsuitable habitat less than 0.6 mile from suitable habitat) would stay under the allowable one per square mile average.
7. Cumulative disturbance was then calculated to determine possible future cumulative impact disturbances within the DDCT. Several well pads have been proposed by another operator (Vantage Energy) and are located within sage grouse habitat within the DDCT for this project. These proposed wells are still under Forest Service review, but were included in the cumulative disturbance acres and cumulative disturbance count in the DDCT, because they are considered possible future disturbances within the DDCT.

Results of the DDCT analysis for existing disturbances within the DDCT are presented in the map below. The cumulative disturbance calculation will be discussed in the Cumulative Impacts section. There are 20,460 acres of suitable sage-grouse habitat within the DDCT analysis area and 5% of this habitat would be 1,023 acres. As of 2011, there are 138 acres of existing disturbance in this area (less than 1%). New allowable suitable habitat disturbance within the DDCT could be up to 885 acres (based on the 5% disturbance threshold).

As of 2011, there are 8 existing anthropogenic disturbance activities within the DDCT area. Existing disturbance density averages 0.25 disturbance/square mile for the 32-square-mile area of the DDCT. New allowable disturbance density within the DDCT could be up to 0.75 disturbance/square mile (based on the 1 anthropogenic disturbance/square mile threshold for the 32-square-mile area). In other words, 24 new disturbance activities would be allowed within the DDCT area.

Population Trend: The Nature Conservancy data show greater sage-grouse populations in Utah to be ―imperiled" (NatureServe 2007). Populations across the West have continued to decline, and the UDWR (2007) estimates that the population in Utah now occupies only 50% of its historical range. Sage-grouse leks (active) and male sage-grouse have been monitored by the UDWR since 1965. Between 1965 and 1995, there was a downward trend in the active sage-grouse lek population overall in the state; an upward trend in the sage-grouse population has been documented between 1995 and 2007 (UDWR 2009). However, this increase may be due to the fact that after the greater sage-grouse was petitioned for listing under the Endangered Species Act (ESA), there was an expanded effort in spring lek counts and searches for new strutting grounds (Forest Service 2006a).

Population estimates show a steady increase in the number of sage-grouse in the Anthro Mountain population from 2002 to 2006, ranging from 45 grouse in 2002 to 132 grouse in 2006; alternate population estimates predict an even higher population size of 54 grouse in 2002 to 186 grouse in 2006 (Forest Service 2007a). Male attendance at leks on Anthro mountain have fluctuated from 15 in 2002, to 44 and 41 in 2006 and 2007 respectively, and then down trend occurred from 2008 to 2010 (4 males in 2010). In 2011 the count went back up slightly (8 males) (Christensen 2011a, Duvuvuei and Messmer 2011). This fluctuation was not isolated to the Anthro population.

The Anthro Mountain population is part of Utah‘s Northeast Region (Uinta Basin) population (Uinta Basin Adaptive Resource Management Local Working Group 2007). The Northeast Region experienced a steady population increase from relatively low numbers prior to 2007, but male lek attendance has shown an overall decline between 2007 and 2011 (UDWR 2011). The male lek attendance in this region increased slightly in 2010 while the Anthro Mountain population continued to show a decline. In 2011, the Anthro Mountain population appeared to increase slightly (based on counting four males in 2010 and eight males in 2011) while the regional population experienced a slight decrease in the number of leks and males counted (UDWR 2011).

Data for the sage-grouse at the state level and forest level were reviewed in the 2006 ANF MIS Report (Forest Service 2006a). Based on the data described in the MIS Report, it was reported that the sage-grouse population in the ANF was stable and experienced a slight upward trend from 2002 through 2006 (Forest Service 2006a). This trend continued through 2007 (Christensen 2011b). However, as stated above, recent trends in the Northeast region show a decrease over the past five years (2007–2011) with the Anthro Mountain population generally experiencing that same trend.

The Forest Plan states that a 10% drop in sage grouse breeding populations on the Forest would trigger a reevaluation of management actions. However, as these fluctuations are Region-wide, and since only 10% of sage grouse populations in the Northeast Region occur on the Forest (Forest Service 2006a), it is likely that the fluctuations are caused by some other factor than management actions on the Forest. It is likely that the drought in the late 1990‘s influenced the low population numbers, and then an increase in precipitation after 2002 influenced and an increase in sage grouse numbers. Weather is also likely to have influenced the recent decline from 2008 to 2011, since the area

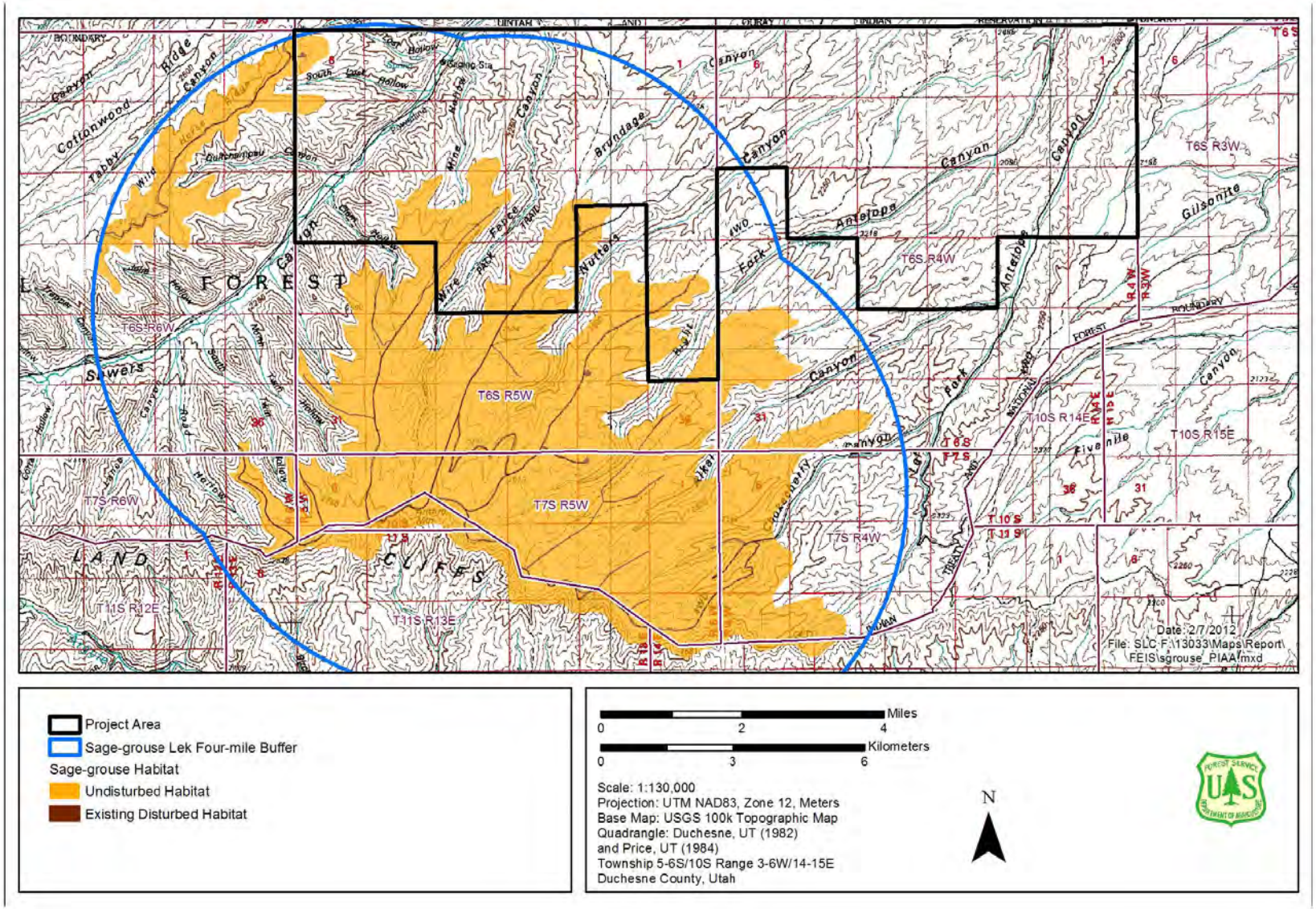


Figure 3-17. Location of Greater Sage-grouse Habitat within 4-mile Lek Buffers (the DDCT analysis area).

(including Anthro mountain) during this same time span experienced heavier snow packs and late, cold springs (Christensen 2011a). Additionally, the Anthro mountain population experienced lower chick survival in 2008 and 2009 due to predation Christensen 2011a). It is likely that as the rabbit populations began to decrease just prior and during the recent decline in sage grouse numbers, that predators shifted their prey base to sage grouse (Christensen 2011a). Therefore, it is likely that higher predation rates also contributed to the recent decline in sage grouse numbers on Anthro.

Threats: Many factors have been identified as contributing to the decline of greater sage-grouse across the western United States. Most of these are directly related to habitat loss and fragmentation, including agriculture, grazing, infrastructure related to energy development, mining, and urbanization. These impacts have contributed to the eradication of sagebrush habitat and the intensive use of lands by domestic livestock and human activities, which have reduced sage-grouse numbers and the quality of sage-grouse habitat. Other factors include the spread of invasive plant species, expansion of pinyon-juniper communities, and, to a lesser extent, disease (NatureServe 2007).

3.9.1.3 Management Indicator Species

MIS are ~~"a~~ny species, group of species, or species habitat element selected to focus management attention for the purpose of resource production, population recovery, maintenance of population viability, or ecosystem diversity" (Forest Service 1991). The 1986 LRMP for the ANF identified 11 vertebrates and one group of invertebrates as MIS (Table 3-34) (Forest Service 1986). Each of these species have established population and management objectives, represent the wildlife and aquatic resources in estimating the effects of management alternatives, and are monitored (in addition to the species' associated habitat) following implementation of the LRMP.

Table 3-34. ANF Management Indicator Species and Associated Habitat Types that Are Known or Have Potential to Occur in or Adjacent to the Project Area.

Species (Scientific Name)	Indicator for Vegetation Community	Habitat in ANF[1]	Potentially Affected[2]
Mammals			
Mule deer (*Odocoileus hemionus*)	Various	Grass/forb, sagebrush, mountain brush, pinyon/juniper, sapling or mature aspen, sapling/mature conifer	Yes
Rocky Mountain elk (*Cervus elaphus*)	Various	Grass/forb, sapling/mature aspen, sapling/old growth conifer	Yes
Birds			
White-tailed ptarmigan (*Lagopus leucurus*)	Alpine Meadow	Alpine tundra, subalpine deciduous shrub, shrubby willows	No
Northern goshawk (*Accipiter gentilis*)	Old Growth Timber	Riparian trees, mature aspen, mature/old growth conifer	Yes

Species (Scientific Name)	Indicator for Vegetation Community	Habitat in ANF[1]	Potentially Affected[2]
Greater sage-grouse (*Centrocercus urophasianus*)	Sagebrush	Grass/forb, meadows, sagebrush	Yes
Golden eagle (*Aquila chrysaetos*)	Cliffs/Rocks	Semi-open landscapes	Yes
Lincoln‘s sparrow (*Melospiza lincolnii*)	Riparian Shrub	Riparian communities	Yes
Song sparrow (*Melospiza melodia*)	Riparian Shrub	Riparian communities	Yes
Warbling vireo (*Vireo gilvus*)	Deciduous Woodlands	Riparian woodlands, montane aspen forests	Yes
Red-naped sapsucker (*Sphyrapicus nuchalis*)	Deciduous Woodlands	Deciduous woodlands	Yes
Fishes			
Cutthroat trout (*Oncorhynchus clarki*)		Streams, rivers, lakes, reservoirs	No
Macroinvertebrates		Streams, rivers, lakes, reservoirs	Yes

[1] Habitat relationships obtained from Forest Service 1986 and Utah Department of Natural Resources Division of Wildlife Resources 2007.

[2] Species that are not potentially affected are not described further in Chapter 3 but are described in the MIS Specialist Report.

MIS to be analyzed include mule deer, Rocky Mountain elk, northern goshawk, greater sage-grouse, golden eagle, Lincoln‘s sparrow, song sparrow, warbling vireo, red-naped sapsucker, and macroinvertebrates, based on the potential of the proposed project to affect individuals of these species or their habitats. A brief summary for each of these species is provided below with the exception of greater sage-grouse and northern goshawk which are discussed above in the sensitive species section.

Mule Deer

The Project Area is within the mule deer Anthro/Nine Mile Unit. Mule deer occur throughout the entire Project Area, and substantial winter range, as well as crucial winter and summer range, is present within the Project Area (Figure 3-18).

Substantial range is defined as habitat that is used frequently by wildlife but is not crucial for population survival; the degradation or unavailability of substantial habitat would not lead to significant declines in carrying capacity and/or wildlife numbers (UDWR 2010). Substantial winter range is distributed across the entire Project Area and surrounding habitat.

Crucial ranges are defined as habitats on which the local population of wildlife depends for survival because there are no alternative ranges or habitats available and are essential to the life history requirements of wildlife; the degradation or unavailability of crucial habitat would lead to significant declines in carrying capacity and/or numbers of wildlife (UDWR 2010). Crucial winter range (598 acres) is located along the Sowers Canyon drainage at the northwest corner of the Project Area. Crucial winter range is also located adjacent to the southeast section of the Project Area along Left Fork Antelope Creek upstream of Alkali Canyon. Crucial summer range is located along the southern edge of the Project Area (1,975 acres), namely within the upper drainages of Mine Hollow, Wire Fence Canyon, Wolf Hollow, and Right Fork Antelope Canyon. Due to the juxtaposition of winter and summer range relative to the Project Area, this area would experience migratory movements as mule deer move along elevational gradients between their seasonal ranges.

The population objective for the Anthro/Nine Mile Unit is 8,500 deer. In 2005 the population estimate was 3,950 deer and the post-2010 hunting season population estimate was 4,600 deer (See population trend information in the MIS report for this project available from the project record). Data for mule deer at the state level and the forest level were reviewed in the 2006 ANF Forest-wide MIS Report (Forest Service 2006d) and a Terrestrial Wildlife Monitoring Report (Christensen 2011b).

Based on the data described in the 2006 Ashley NF Forest-wide MIS Report and the 2011 Terrestrial Wildlife Monitoring Report, it appears that the mule deer population in the ANF is stable to slightly decreasing, but sustains an annual harvest and remains viable. Based on these same data, it also appears that the ANF provides mule deer habitat that is well distributed across the forest and is sufficient to sustain a viable mule deer population (Forest Service 2006d, Christensen 2011b).

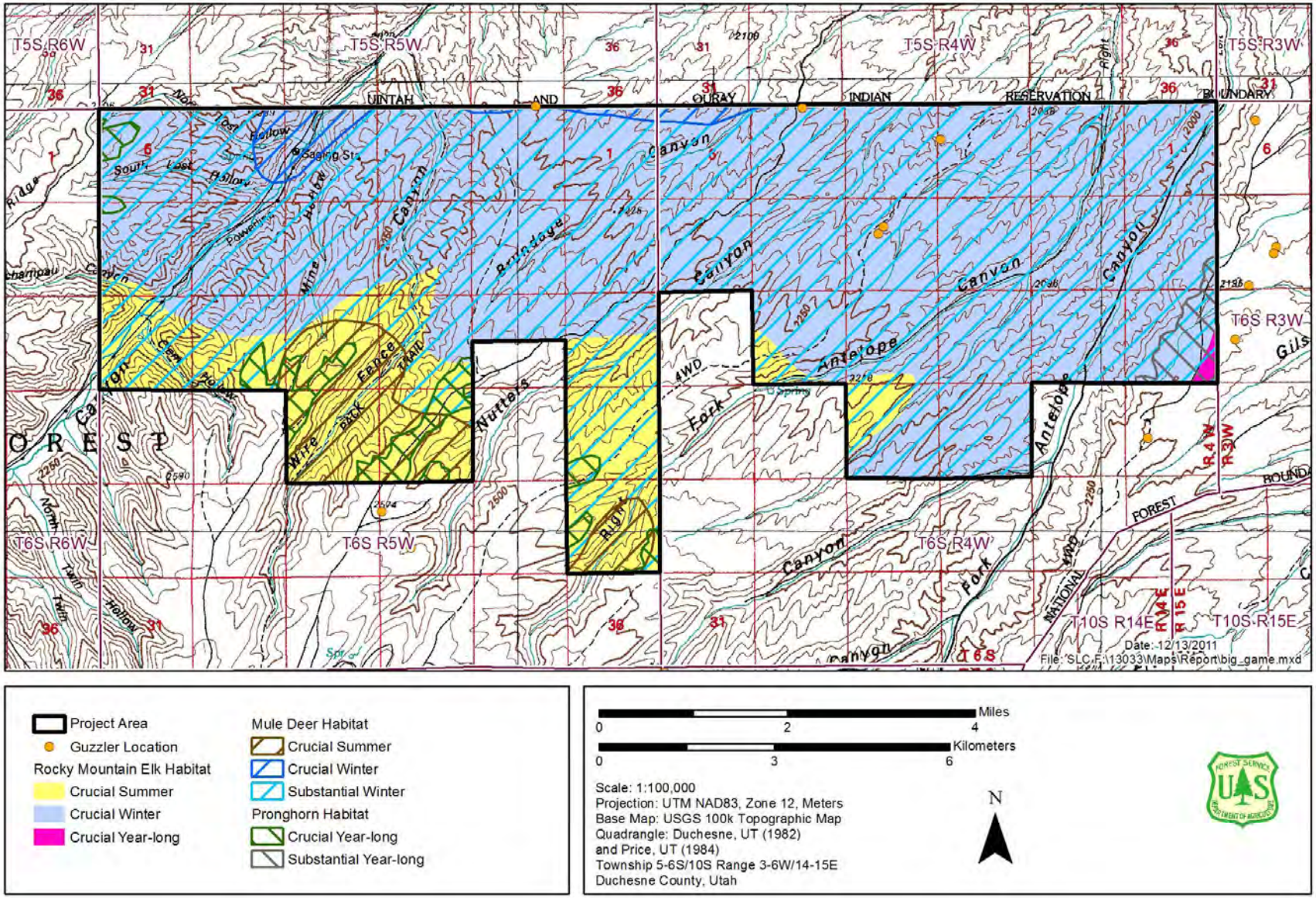


Figure 3-18. Mule Deer, Elk, and Pronghorn Habitat (UDWR 2010).

Rocky Mountain elk

Elk occur throughout the proposed Project Area, and both crucial winter and summer range occur within the Project Area (Figure 3-18). The Project Area lies immediately west of crucial year-long range (a small portion [57 acres] is contained within the extreme southeast corner of the Project Area) and north of substantial year-long range. Crucial summer range occurs within the southwestern corner of the Project Area (5,424 acres), and includes the upper drainages of Sowers Canyon, Mine Hollow, Wire Fence Canyon, and Wolf Hollow. The remainder of the Project Area (20,420 acres) is located on crucial winter range (Figure 3-18). Due to the juxtaposition of winter and summer range relative to the Project Area, this area would experience migratory movements as elk move along elevational gradients between their seasonal ranges.

The Project Area is within the Anthro/Nine Mile elk management subunit. Herd size population estimates from the post-2010 hunting season were 1,400 elk; the population objective for the herd size is 700 elk for this unit. More population trend information is provided in the MIS report prepared for this Project. Data for elk at the state level and the forest level were reviewed in the 2006 ANF Forest-wide MIS Report (Forest Service 2006d) and a 2011 Terrestrial Wildlife Monitoring Report (Christensen 2011b).

Based on the data described in the 2006 Ashley NF Forest-wide MIS Report and the 2011 Terrestrial Wildlife Monitoring Report, it appears that the elk population in the ANF is stable, sustains an annual harvest, and remains viable. Based on these same data, it also appears that the ANF provides elk habitat that is well distributed across the forest and is sufficient to sustain a viable elk population (Forest Service 2006d, Christensen 2011b).

Golden Eagles

Golden eagles are typically found across semi-open landscapes, and nesting occurs on cliffs or in large trees. Recorded sightings of golden eagles in the ANF appear to be distributed across the forest (Forest Service 2006c). This species has been documented within the Project Area as recently as 2008, but no nests have been found (Christensen 2011b). Data for the golden eagle at the state level and the forest level were reviewed in the 2006 ANF Forest-wide MIS Report (Forest Service 2006d) and a 2006–2011 Terrestrial Wildlife Monitoring Report (Christensen 2011b). Based on the data described in the Ashley NF Forest-wide MIS Report and 2006-2011 Terrestrial Wildlife Monitoring Report, it is believed that the golden eagle population trend in the ANF is stable but at low numbers. It is also believed that the ANF provides golden eagle habitat that is well distributed across the forest (Forest Service 2006d; Christensen 2011b). For a full discussion on the golden eagle refer to the project record.

Lincoln’s Sparrow

The Lincoln‘s sparrow is a common breeding species during summer in the high mountains and plateaus of Utah. This species typically builds ground-level nests in dense brushy areas throughout wet meadows, bogs, and riparian thickets; migration and winter-use habitats include a wider diversity of habitat types (UDWR 2007). Since riparian within the Project Area occurs at a lower elevation than what is typically associated with Lincoln's sparrows, the species may not occur within the Project Area. However, since riparian does occur within the Project Area, this species will be evaluated. Data for the Lincoln‘s sparrow at the state level and forest level were reviewed in the 2006 ANF Forest-wide MIS Report (Forest Service 2006d) and a 2011 Terrestrial Wildlife Monitoring Report (Christensen 2011b). Foraging habitat for the Lincoln‘s sparrow may

occur in the riparian shrublands of Sowers Creek (Forest Service 2006d) but this species is unlikely to nest there due to the elevation. There are 122 linear acres of riparian habitat along Sowers Creek in the Project Area (Figure 3-15). Surveys have occurred in Sowers Creek as recently as 2010, but the Lincoln‘s sparrow has not been observed (Christensen 2011b). Based on the data described in the 2006 Forest-wide MIS Report and the 2011 Terrestrial Wildlife Monitoring Report, it is believed that the Lincoln‘s sparrow population trend in the ANF is stable. It is also believed that the ANF provides habitat that is well distributed across the forest and is sufficient to sustain viable Lincoln‘s sparrow populations (Forest Service 2006d; Christensen 2011b).

Song Sparrow

The song sparrow is a common year-round resident throughout Utah and occupies a variety of habitats. Breeding occurs mainly in streamside thickets and marshes, although it is also common in forest edges and clearings; meadows and bogs; and residential areas (UDWR 2007). Song sparrows were detected in the Project Area during field investigations in July 2007 (SWCA 2007) and during Forest Service surveys in 2009 and 2010 (Christensen 2011b). In 2011, the song sparrow was detected within the Project Area (Christensen 2011c). Nesting and foraging habitat for the song sparrow occurs in the riparian shrublands along Sowers Creek in the Project Area (122 linear acres) (Forest Service 2006d). Data for the song sparrow at the state level and forest level were reviewed in the 2006 ANF Forest-wide MIS Report (Forest Service 2006d) and a 2011 Terrestrial Wildlife Monitoring Report (Christensen 2011b). Based on the data described in the Ashley NF 2006 Forest-wide MIS Report and the 2011 Terrestrial Wildlife Monitoring Report, it is believed that the song sparrow population trend in the ANF is stable. Based on these same Reports, it is also believed that the ANF provides habitat that is well distributed across the forest and is sufficient to sustain viable song sparrow populations (Forest Service 2006d; Christensen 2011b).

Warbling Vireos

Warbling vireos inhabit open deciduous and mixed deciduous-coniferous forests in riparian areas and montane aspen habitats throughout Utah (UDWR 2007). Warbling vireos use all structural stages of aspen and cottonwood (Populus spp.) riparian habitats for feeding and cover. These habitats are available in the Project Area (Figure 3-15). Warbling vireos were detected in the Project Area during field investigations conducted in July 2007 (SWCA 2007). Subsequent surveys within and near the Project Area by the Forest Service did not detect any warbling vireos (Christensen 2011b). Data for the warbling vireo at the state level and forest level were reviewed in the 2006 ANF Forest-wide MIS Report (Forest Service 2006d) and a 2006–2011 Terrestrial Wildlife Monitoring Report (Christensen 2011b). Based on the data described in these Reports, it is believed that the warbling vireo population trend in the ANF is stable. Based on these same Reports, it is also believed that the ANF provides habitat that is well distributed across the forest and is sufficient to sustain viable populations of the warbling vireo (Forest Service 2006d; Christensen 2011b).

Red-naped Sapsucker

The red-naped sapsucker inhabits coniferous forests and montane riparian woodlands throughout Utah (UDWR 2007). This species is a common resident in mid-elevation riparian woodlands throughout Utah, and breeds primarily in deciduous and mixed forests that include aspen and other hardwoods throughout the western United States and southwestern Canada. The presence of aspen stands within the southwestern portion of the

Project Area may provide habitat for this species (Figure 3-15). Data for the red-naped sapsucker at the state level and forest level were reviewed in the 2006 Forest-wide ANF MIS Report (Forest Service 2006d) and a 2006–2011 Terrestrial Wildlife Monitoring Report (Christensen 2011b). Based on the data described in these Reports, it is believed that the red-naped sapsucker population trend in the ANF is stable. Based on these same Reports, it is also believed that the ANF provides habitat that is well distributed across the forest and is sufficient to sustain viable populations of the red-naped sapsucker (Forest Service 2006d; Christensen 2011b).

Macroinvertebrates

Macroinvertebrates serve as excellent indicators of water quality and aquatic habitat conditions. Aquatic macroinvertebrates are found in perennial waters including lakes, streams, ponds, marshes, and puddles and help maintain water quality by eating bacteria and dead, decaying plants and animals. The overall quality of the water is a major determinant as to which species are present. High-quality systems (typically represented by high levels of dissolved oxygen) are represented by such species as mayflies and stoneflies; low-quality systems are often associated with lower dissolved oxygen levels and may be represented by such species as aquatic worms and leeches. Macroinvertebrates serve as good indicators of water quality since they are sensitive to changes in the aquatic ecosystem, they reflect changes in water quality systems over short periods of time, and they can be easily and readily collected.

There is perennial water in Sowers Creek located in Sowers Canyon. The other canyons in the Project Area contain intermittent stream flow associated with spring runoff and storm events. Macroinvertebrates were sampled on Sowers Creek on September 5, 2008. Results of the analysis indicate a BCI of 113. However, the analysis also revealed low density and diversity of macroinvertebrates, which is consistent with the highly erosive conditions found in Sowers Canyon. The macroinvertebrate assemblage displays all the signs of a heavily impacted site. The results indicate a high level of disturbance and warm water conditions. Indicators of high fine sediment and low habitat complexity are prevalent. Furthermore, samples collected indicate high alkalinity and conductivity (Forest Service 2009d).

3.9.1.4 Migratory Birds

In order to promote the conservation of migratory birds, several additional species have been given specific consideration when analyzing the effects of proposed management actions. These species are identified in a Memorandum of Understanding between the Forest Service, BLM, and the USFWS (USFWS 2008). These species have been identified as priority species for conservation due to their declining abundance or distribution, or their vulnerability to local and/or range-wide risk factors. Other priority species are identified by the Utah Partners in Flight (Parrish et al. 2002).

Migratory bird species that could occur within or near the Project Area, based on their association with pinyon-juniper woodland, sagebrush, brushlands, riparian, and deciduous or coniferous forest, including Douglas-fir, and aspen, are presented in Table 3-44.

3.9.1.5 Other Wildlife Species of Concern

Pronghorn are common throughout Utah, and occur primarily in grassland, and shrubsteppe habitat with open, flat. A strong forb component in the vegetative mix is important for sustaining pronghorn populations. The extreme southeast portion of the

Project Area contains 802 acres of crucial pronghorn habitat and 363 acres of substantial year-long pronghorn habitat (Figure 3-18). Pronghorn in the Nine Mile Anthro subunit had a population estimate of 325 antelope in 2008. This subunit showed a downward trend in population over a 10-year period prior to 2008 (UDWR 2009).

The Duchesne River to the north and down-gradient from the Project Area sustains populations of brown trout (*Salmo trutta*), flannelmouth sucker (*Catostomus latipinnis*) (a conservation agreement species), and northern leopard frog (*Rana pipiens*). The Duchesne River supports several different life stages of these species and is very important to both sport fish and native aquatic communities. While the Project Area does not encompass many perennial streams or any streams that sustain fish, maintenance of the upstream watershed is essential to the health of downstream aquatic habitats.

3.9.2 Environmental Consequences

This section considers the environmental consequences of the Proposed Action and three alternatives to four endangered fishes of the Upper Colorado River Basin, six Forest Service Sensitive Species, 10 ANF MIS, migratory birds, and other species of concern.

Forest Service Sensitive Species have limited distributions or numbers, generally with specific habitat requirements. Impacts to these special status species therefore must 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. MIS are species with special habitat needs that may be influenced significantly by planned management programs; species commonly hunted, fished, or trapped; non-game species of special interest; and additional plant or animal species selected because their population changes are believed to indicate the effects of management activities on other species of selected major biological communities or on water quality. Population changes by these species are believed to indicate the effects of management activities. Impacts to these species therefore must be viewed in the context of individual factors that are most important to preserving, enhancing, and managing individual species for the purposes of animal diversity.

Potential direct adverse effects to federally listed species, Forest Service Sensitive Species, and ANF MIS could include the following.

- Risk of direct mortality during construction of well pads, roads, and ancillary facilities.
- Risk of direct mortality from vehicle collisions.
- Contamination or mortality from oil in reserve pits.
- 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.

Potential indirect adverse impacts could include the following.

- Disruption of birds' nesting, foraging, migration, and other activity patterns and timing due to increased road density and human activity.
- Fragmentation and isolation of connected habitats, including reduced habitat patch size, increase in road density, and reduced distance to areas of disturbance, and the potential displacement of wildlife.

- Increases in the potential for poaching or harassment of wildlife due to the relative level of access provided from project-related roads and increased traffic.

Cumulative impacts include past, present, and reasonably foreseeable future actions (RFFAs) regarding energy development projects within the cumulative impact analysis area (CIAA). The CIAA for most Forest Service sensitive species is the Forest Service Analysis Area (FSAA), a total area of 186,923 acres. This CIAA/FSAA is bounded by Highway 191 to the west, the First Standard Parallel to the north, Wells Draw road to the east, and Five Mile Canyon Road and the southern Forest boundary of the South Unit on the south.

The following subsections provide a brief overview of potential impacts to federally listed species, USDA Forest Service Region 4 Sensitive Species, ANF MIS, migratory birds, and other species of concern that may occur within the Project Area. More detailed information is provided in the Biological Assessment (federally listed species), Biological Evaluation (Forest Service Region 4 Sensitive Species), and the MIS Report (available from the project record).

3.9.2.1 Federally Listed Species

Aquatic Species Common to all Action Alternatives

Federally listed species do not occur within the Project Area and would not be affected by the proposed actions with the exception of the four endangered fish, Therefore, only the fish will be considered further in this document.

Populations of endangered fishes of the Upper Colorado River Basin are present approximately 20 miles downstream in the Duchesne and Green Rivers. Water used during project activities would come from existing permitted water sources. Any water withdrawals associated with the proposed project are considered to be a new depletion to the Upper Colorado River Basin and likely to adversely affect the federally endangered fishes of the Upper Colorado River Basin.

Therefore, the determination of ―may affect, and is likely to adversely affect" the four endangered fishes of the Upper Colorado River Basin was made for the Proposed Action in the Biological Assessment. Concurrence on this determination was received from the United States Fish and Wildlife Service (USFWS) in the final biological opinion for impacts to the four endangered fishes of the Upper Colorado River Basin on February 9, 2012. Furthermore, the Upper Colorado River Endangered Fish Recovery Program (Recovery Program) acts as the reasonable and prudent alternative to avoid jeopardy. The USFWS believes the Recovery Program will adequately address effects to the species. Other than water depletion, there are no other affects to the four endangered fishes of the Upper Colorado River Basin associated with the Proposed Action.

3.9.2.2 Forest Service Sensitive Wildlife Species

Impacts Common to all Alternatives

Direct impacts to Forest Service sensitive wildlife species due to construction of road/pipeline ROWs, well pads, and associated facilities include loss of available habitat used for foraging, nesting, and shelter may occur. Additionally, the utilization of habitats immediately adjacent to these areas would be affected due to the presence of human activities, noise, and potentially perceived visual threats. The construction of new roads fragments wildlife habitat and creates a network of habitat patches across the landscape

(Dobson et al. 1999) and may isolate species or displace travel routes to other locations. Increased mortality from animal/vehicle collisions is a potential direct impact that may occur due to increased traffic within the Project Area and along access roads. Noise from traffic may also create a buffer zone that displaces animals at further distances from the roadway. This ―edge effect" may also represent less suitable habitat due to the presence of invasive plant and animal species that utilize roads as conduits for dispersal.

The No Action Alternative (Alternative 1) would not further affect wildlife since no action would occur. Therefore, the analysis will focus on impacts from the Action Alternatives (Alternatives 2, 3, and 4).

Sage Grouse

Impacts to the greater sage-grouse would be considered substantial if more than 5% of the DDCT analysis area was disturbed or disturbance density within the DDCT analysis area exceeded an average of one disturbance/square mile. Greater sage-grouse habitat loss, degradation, and fragmentation are all likely to occur in the Project Area due to the construction of roads and well pads, and human activity and noise associated with such infrastructure. In a review of seven scientific investigations studying the relationships between energy development and sage-grouse, Naugle et al. (In press) found that all seven studies reported negative impacts of energy development on sage-grouse. Well pads densities, and the indirect impacts associated with well pad development, play a key role in affecting sage-grouse populations. These studies have shown that oil and gas development reduces sage-grouse use of leks and winter habitat (Doherty et al. 2008; Walker et al. 2007) and negatively affects breeding sage-grouse populations once well pad densities exceed one well pad per square mile (Holloran 2005). Densities of eight wells per section were observed to exceed the threshold of sage-grouse tolerance (Holloran 2005; Walker et al. 2007; Doherty et al. 2008) and areas with higher well densities have been avoided by nesting females (Holloran 2005).

High well pad densities have also resulted in decreased male lek attendance (Holloran 2005) and the indirect impacts of oil and gas development are far-reaching. Holloran (2005) found that active drilling within 3.1 miles of a lek caused reductions in the number of breeding males that used that lek. Walker et al. (2007) determined that energy development had negative impacts on lek attendance and persistence out to an approximate 2-mile distance from the lek and that lek persistence was positively influenced be the proportion of sagebrush habitat present within approximately 4 miles of the lek. Harju et al. (2010) conducted an analysis of seven energy development regions in Wyoming and determined that lek attendance in areas with well pad densities of four per square mile experienced 13% to 74% lower attendance than leks removed from well pads at distances greater than 5.3 miles; densities of eight per square mile experienced 77% to 79% lower attendance. Measurable effects on decreased lek attendance were observed in as little as two years (Harju et al. 2010); other studies have reported three to four years (Holloran 2005; Kaiser 2006; Holloran et al. 2007; Walker et al. 2007).

Other indirect impacts of well pads, such as traffic and noise associated with drilling and production operations, may negatively impact sage-grouse populations. Holloran (2005) found a positive correlation between declines in displaying males at leks and increased traffic volumes within 3 km (approximately 2 miles) of a lek and greater noise intensity. Even the upgrading of roads (haul roads associated with mining activity) has resulted in a decline in the number of displaying males at leks located near those roads (Remington and Braun 1991). Noise associated with drilling activities and traffic have resulted in

displacement of sage-grouse (Connelly et al. 2004) and can impact lek attendance from distances of at least 5 km (Holloran 2005). Lek abandonment can also be due to repeated disturbance by raptors perched on powerlines, infrastructure that is often associated with development fields (Braun et al. 2002; Connely et al. 2004). Predation by raptors on grouse attending lek sites has also been observed (Connelly et al. 2000).

The responses of sage-grouse to these impacts as evidenced by lower yearling recruitment have resulted in lower numbers of males using leks near natural gas development, thus resulting in declining population trends and persistence over time (Kaiser 2006; Walker et al. 2007). Kaiser (2006) found that yearling males avoided leks located in highly developed gas fields and females breeding or nesting in gas fields produced fewer and smaller broods compared to females removed from gas fields. The lack of success and avoidance of nesting habitat in close proximity to gas development areas subsequently results in higher nest densities, which has resulted in lower success rate (Holloran and Anderson 2005; Aldridge and Boyce 2007). Yearling males and females reared by females nesting within gas development areas had lower annual survival compared to yearlings raised in areas removed from such development (Holloran et al. 2010). Lek abandonment can also be caused by yearlings dispersing further from energy development infrastructure contributing to abandonment (Holloran et al. 2010). Sage-grouse that avoided infrastructure in one or more seasons have resulted in population declines (Doherty et al. 2008). Aside from nesting and brood-rearing habitat, avoidance of infrastructure by sage-grouse using winter habitat has been observed and avoidance of otherwise suitable, high-quality winter habitat has occurred at well densities of 12 wells per 4 km2, or 1.5 square miles (Doherty et al. 2008).

No sage-grouse leks are known to occur within the Project Area; one lek is located immediately adjacent to the Project Area on a ridgeline between Wire Fence Canyon and Nutters Canyon. Three additional leks have 4-mile buffers that extend into the Project Area. The locations of known leks and 4-mile buffers adjacent to the Project Area are assumed to represent optimal lek and early brood-rearing habitat, which is defined as open sites surrounded by sagebrush that may be located in clearings or disturbed areas where sagebrush density is low, such as exposed ridges, knolls, or grassy swales (Schroeder et al. 1999), in addition to sagebrush uplands adjacent to nest sites that provide a sagebrush overstory, herbaceous understory, and abundant insects for foraging (Forest Service 2007c).

Sage-grouse have an increased susceptibility to West Nile virus due to their interaction with artificial surface water sources which may harbor insects that vector West Nile virus (Naugle et al. 2004). Disturbance of breeding, nesting, brood-rearing, and wintering greater sage-grouse and their habitats would increase as a result of increased habitat removal, road construction, and associated noise, traffic, and human activities. Disturbance may cause sage-grouse to be flushed from leks, females to discontinue breeding activity, lek and nest abandonment, and avoidance of habitat which could result in reduced breeding initiation, reproductive success, and survival. Impacts to leks and other important habitats (e.g., nesting, winter) may be serious enough to cause abandonment of the area. Even if alternate lek sites are established or existing leks at alternate locations are used, it is assumed that less than optimal conditions would prevail, resulting in decreased breeding success, even though lek availability is not considered to be a limiting factor for sage-grouse (USFWS 2010).

In addition to habitat loss, the construction of roads could impact sage-grouse populations by creating permanent travel routes, improving public access, increasing long-term traffic-

related disturbance in previously inaccessible regions, indirect noise impacts to leks, and direct mortality (Braun 1998). Roads also provide a clear pathway for predators to move unimpeded by vegetation or other obstructions, which could in turn draw predators into areas where they may have been absent or less abundant, thus increasing predation opportunities (Lyon 2000). The road-effect distance, which is the distance from a road at which a population density decrease is detected, is positively correlated with increased traffic density and speed and is more critical in years when wildlife populations are low (Foreman and Alexander 1998). A study on coal mining activities and oil field development in North Park, Colorado, found that greater sage-grouse populations in areas experiencing disturbance decreased in relation to surrounding undisturbed populations (Braun 1986, 1987). Because adult male greater sage-grouse establish fidelity to specific leks, Braun (1986) hypothesized that mining activity and large-scale habitat loss occurring adjacent to leks may contribute to a reduction in the number of yearling male recruits to those areas and that the increased road construction associated with such development may also impact greater sage-grouse populations. Leks within the Anthro Mountain sage grouse population do not occur within the Project Area, but one lek does occur immediately adjacent to the Project Area boundary. Access to proposed well pads on Wire Fence ridge would likely be along Forest Service system roads (e.g., Nutter‘s Ridge Road and Wire Fence Road) that pass through two leks. This would likely result in direct mortality due to vehicle collisions, decreased lek attendance leading to decreased productivity, and decreased nest success.

Because grouse populations typically inhabit large interconnected expanses of sagebrush, they have been characterized as a landscape-scale species (Patterson 1952; Wakkinen 1990). Therefore, conserving landscapes with suitable winter habitat also may be important for species conservation (Eng and Schladweiler 1972). Johnson and Braun (1999) noted that adult survival is the primary determinant of population growth in sage-grouse and that wintering habitat is just as, if not more, important for grouse as nesting habitat. Wintering sage-grouse are more likely to avoid areas with energy development, even when suitable habitat is present; sage-grouse in the Powder River Basin selected sagebrush stands greater than 4 km2 and were 1.3 times more likely to occupy sagebrush habitats with no well development (Doherty et al. 2008). Similarly, Walker et al. (2007) found that leks in well fields had 46% fewer male grouse per active lek than outside developed areas and that lek persistence was positively influenced by the proportion of sagebrush habitat within 6.4 km of the lek. Naugle et al. (2006) found that energy development negatively affects breeding sage-grouse populations once well densities exceed one well per square mile. While sage-grouse have used highly fragmented habitats in some oil fields and reclaimed areas, population levels in these areas are below pre-disturbance numbers (Connelly et al. 2004). Furthermore, studies conducted in Montana, Wyoming, and Colorado suggest that some recovery of greater sage-grouse populations may occur after a site has been developed and subsequently reclaimed following energy development, road construction, and other human disturbances (Braun 1998). However, there has been no evidence that populations attain their pre-disturbance levels.

Although information is not available regarding minimum sagebrush patch sizes required by sage-grouse (USFWS 2010), maintaining large, continuous tracts of suitable habitat protected from disturbance is likely critical to the sustainability of greater sage-grouse populations. Sage-grouse may cover extensive distances within and between seasons, so maintaining optimal habitat linkages between seasonal use areas is critical. Lyon (2000) reported that 74% of the hens from disturbed leks nested more than 1.9 miles from the lek, while 91% of the hens from undisturbed leks nested within 1.9 miles of the lek. Lyon

(2000) also reported that hens on disturbed leks demonstrated lower nest initiation rates, traveled twice as far to nest sites, and selected higher total shrub canopy cover and live sagebrush canopy cover than hens from undisturbed leks. Therefore, for lek sites closer to existing and proposed infrastructure, maintaining linkages to optimal habitat removed from energy-related activities is important to reduce pressure on nesting females. This is particularly important because females maintain site fidelity to nesting areas surrounding a lek, even in areas of high disturbance (Lyon 2000).

Loss of mature sagebrush cover, which may take over 100 years to become fully established, directly affects year-round habitat and forage for the greater sage-grouse, as well as other sagebrush-obligate species (Braun 1998; Slater 2003). Energy development could intensify weed proliferation or conversion of sagebrush to other community types, reducing the amount of suitable habitat for sage-grouse. Within comparatively intact sagebrush ecosystems, restoring up to 20% of degraded nesting and early brood-rearing habitats and 30% of the winter habitat may improve habitat conditions. Restoration treatments may consist of providing herbaceous understory, creating open patches of herbaceous vegetation, thinning dense sagebrush canopies exceeding 30% cover, creating openings within dense sagebrush, regenerating the shrub component by setting back succession, or enhancing herbaceous understory by reducing herbivory. However, at some point, it becomes ineffective to mitigate habitat loss by restoring vegetation because the temporary loss of nesting and roosting habitat and decreased food availability during treatment and mitigation creates an unacceptable level of impacts to greater sage-grouse (Connelly et al. 2000). Also, when the availability of forbs and grasses decreases, broods move longer distances, expend more energy, and increase risk of predation (Lyon 2000).

In areas where 40% of greater sage-grouse nesting, early brood-rearing, and/or winter habitat has been lost or severely degraded within the range of a population, Connelly et al. (2000) suggest focusing management on protecting any remaining sagebrush that is in any way suitable for these functions. The habitat within the 4-mile lek buffer is particularly valuable given existing and proposed energy-related activities surrounding the Project Area. As such, developing well pads and roadways outside these zones may provide an additional buffer between sage-grouse activities and energy-related infrastructure. Although no leks are within the Project Area, limiting and/or restricting activities within buffer zones would not only provide a greater distance between energy development activities and lek, nesting, and brood-rearing habitats, but may serve as a future refuge should additional development activities occur in the future. Such measures, in addition to the mitigation measures listed below, could be achieved by arranging well pads along existing roadways or through directional drilling methods. However, site-specific situations vary and the success in reducing impacts using standard mitigation measures is variable.

There are 2,102 acres of sage grouse habitat within the Project Area. This is 10% of the total sage grouse habitat (20,460) within the DDCT. Existing disturbance was calculated at the both the project level and the DDCT level. Table 3-35 provides the acres of disturbance to sage-grouse habitat by alternative within the project if no mitigations are applied to either of the action alternatives, including Alternative 4.

There are 16 acres of existing disturbance to sage-grouse habitat within the Project Area. There would be between 108 to 117 acres of additional surface disturbance within designated sage grouse habitat under the alternatives. Total disturbance within the Project Area (16 existing acres combined with the additional surface disturbance per alternative) would be 124 to 133 acres of disturbance to sage grouse habitat depending on the

alternative. There is currently 0.1% of sage grouse habitat within the Project Area that is disturbed. The alternatives would add 5.1% to 5.6% of additional disturbance to sage grouse habitat within the Project Area depending on the alternative. Total % disturbance within the Project Area (0.1% existing disturbance combined with the additional surface disturbance per alternative) would be 5.9% to 6.4% disturbance to sage grouse habitat depending on the alternative. At the project level, Table 3-35 shows that the alternatives, without adequate mitigations would be over the 5% allowable sage grouse habitat disturbance threshold. Additionally well pad density would be over the one well pad/square mile disturbance threshold. Without adequate mitigations to protect sage grouse, the project under the alternatives would likely preclude sage grouse from using habitat within the Project Area and would likely adversely affect the Anthro sage grouse population.

Table 3-35. Disturbance to Greater Sage-grouse Habitat by Alternative If No Mitigations Are Applied.

	Existing Conditions	Alternative 1 (No Action)	Alternative 2 (Proposed Action)	Alternative 3	Alternative 4
Acres of disturbance to habitat in Project Area	16	0	111	117	108
% disturbance in Project Area[1]	0.8	0	5.3	5.6	5.1

[1] Percent of the 2,102 acres of suitable (disturbed and undisturbed) habitat within the Project Area that would be disturbed.

Table 3-36 below depicts habitat disturbance at the DDCT level per alternative if no mitigations are applied to either action alternatives, including Alternative 4. This includes existing disturbance within the DDCT and additional disturbance per alternative. The baseline [existing] disturbance in the DDCT area is 138 acres. For the Proposed Action, there would be an additional 111 acres of disturbance beyond existing conditions to undisturbed sage-grouse habitat in the DDCT area (249 acres of total disturbance). Under Alternative 3 there would be an additional 117 acres of disturbance in the DDCT acres (255 acres of total disturbance). There would be an additional 108 acres of disturbance beyond existing conditions under Alternative 4 (246 acres of total disturbance). Of the action alternatives, Alternative 3 would have the greatest impact to sage-grouse habitat within the DDCT area; Alternative 4 would have the least. For all action alternatives, project development would result in 1.2% of the sage-grouse habitat within the DDCT area being disturbed, thus falling below the 5% disturbance threshold. Average well pad density, however, would exceed the one well pad/square mile threshold for all action alternatives; Alternative 4 would result in the lowest disturbance density. From the analysis in Tables 3-35 and 3-36, it is likely that all action alternatives, without adequate mitigations to protect sage grouse, would have adverse affects to the local sage grouse population. Although, the analysis shows the action alternatives under the 5% allowable habitat disturbance threshold for the DDCT, it is evident that the disturbance density

within the DDCT is beyond the tolerance level of sage grouse (above the one well pad/square mile threshold). Additionally as depicted in Table 3-35, the disturbance under the alternatives, without adequate mitigations, would be above both the 5% allowable habitat disturbance and the disturbance density threshold within the Project Area. Also, access to a portion of the Project Area would likely be along existing Forest Service roads to the south of the Project Area that pass in close proximity to 3 leks. Frequent traffic and large trucks associated with project activities along these roads would likely produce noise and disturbance to habitat along these roads, which is likely to cause breeding, nesting, brood rearing, and wintering sage grouse to avoid the area. As the Anthro sage grouse population is relatively small and has seen a recent decline, adverse impacts to this population could result in a further decline that could lead to extirpation of the population.

Table 3-36. Acres of Disturbance to Suitable Sage-grouse Habitat and Disturbance Density within the DDCT Area If No Mitigations Are Applied.

	Existing Conditions within DDCT	Alternative 1 (No Action)	Alternative 2 (Proposed Action)	Alternative 3	Alternative 4
Acres of sage-grouse habitat disturbance[1]	138 (0.7%)	138 (0.7%)	249 (1.2%)	255 (1.2%)	246 (1.2%)
Disturbance density[2]	0.38	0.38	2.59	2.59	1.78

[1] Total acres of existing and proposed disturbance and (in parentheses) percent of the 20,460 acres of habitat within the DDCT area that would be disturbed.

[3] Total disturbances within the DDCT divided by the 32 square miles of habitat within the DDCT area.

No mitigation measures for sage-grouse are proposed under Alternative 2. Under Alternative 3, phased drilling would be implemented to concentrate construction activities in order to minimize noise, traffic, and other construction-related activities in large portions of the Project Area. In addition, a specific POD to limit and/or mitigate sagebrush habitat fragmentation in order to maintain large, unfragmented blocks of wildlife habitat and migration corridors would be developed and would include such elements as reducing surface density of facilities, roads, pipelines, and other ROWs; focusing development near existing ROWs; clustering facilities; minimizing oil- and gas-related activities in sagebrush habitats; and developing a wildlife monitoring plan. Raptor perch avoidance devices would also be constructed to reduce potential predation on sage-grouse. However, as evidenced in the sage grouse literature, these mitigations would not be adequate to protect sage grouse. Alternative 3 would still result in adverse impacts to the Anthro sage grouse population.

Alternative 4 has the least impacts to sage grouse. However, as described above, without adequate mitigations, this alternative would still lead to adverse impacts the Anthro sage grouse population. Therefore mitigation measures will be required for Alternative 4 to protect sage grouse and sage grouse habitat. Mitigation measures proposed under Alternative 4 aim to reduce the potential threats that the project may have on the Anthro Mountain sage-grouse population, thus contributing to maintaining the long-term viability of the population. These mitigation measures are based on results of ongoing research studies that are investigating the interactions between energy development activities and sage-grouse population dynamics across a landscape. Well pad and road density, in

addition to the proportion of disturbance relative to sage-grouse habitat, have followed the DDCT process which is being used in the state of Wyoming and which identifies thresholds for both 1) well pad and road disturbance densities, and 2) sage-grouse habitat disturbance that has been documented to maintain sage-grouse population dynamics. Under Alternative 4, within 4 miles of a lek, a mitigation buffers sage grouse habitat by 0.6 mile. The mitigation would restrict well pad and road density to an average of one well pad/square mile within sage grouse habitat and within the 0.6 mile buffer. This mitigation would be applied to the project area. Any well pad placement within sage grouse habitat would count towards the 24 additional disturbances that are allowed within the DDCT. Also, no more than 5% of sage-grouse habitat within the project area would be allowed to be disturbed. These mitigation measures would ensure that the disturbance density (average of one disturbance/square mile) and the habitat disturbance threshold (5% allowable habitat disturbance) within the DDCT would not be exceeded.

Also under Alternative 4, measures to minimize project activities (e.g., maintenance, traffic, or work-over rigs) on breeding sage-grouse and their activities would include timing restrictions within sage-grouse habitat and a 0.6-mile buffer during the breeding season (March 1–May 31). Additional timing restrictions would be applied during the nesting season (March 1–June 30) to well pads in sage-grouse habitat in order to prevent nest abandonment, maintain reproductive success, and prevent females from discontinuing breeding activities. Winter timing restrictions (November 15–March 1) would also be implemented along ridge tops within 4 miles of a lek to reduce the threat of well pad construction, road construction, drilling activities, and traffic to migrating sage-grouse.

Additionally under Alternative 4, to address potential decreases in sage-grouse lek attendance, surface disturbance (including well pads, roads, and any structures) would be prohibited within 0.6 mile of lek sites in order to reduce any direct and indirect impacts often associated with well pad construction and operation (e.g., habitat loss, noise, visual impacts, reduction of habitat quality, traffic, use of wells as perching devices for raptors). Further measures to reduce noise levels to an acceptable level that would not disturb strutting birds or cause lek abandonment would include muffling well pad activities within 3.1 miles of a lek to no more than 45dB at a lek site and orienting mufflers at these well pads in a direction away from leks. To reduce the threat that project associated traffic associated with drilling, production, and maintenance activities and the noise and visual impacts associated with those activities would have on lek attendance, productivity, and habitat use along those roads, all project-related activities and vehicle access would be prohibited on both the Nutters Ridge Road (FSR 333) and Wire Fence Ridge Road (FSR 332) south of Berry Petroleum‘s current lease area. If access was allowed on these portions of the roads, project-related traffic along these roads could result in sage-grouse avoidance of the habitat along these roads and contribute to the loss of viability of this population. Measures implemented to reduce the risk of predation on sage-grouse by raptors would include establishing low profile tanks for all well pads within sage-grouse habitat.

Further mitigation measures for Alternative 4 include, within 4 miles of a lek, locate well pads as close to the edge of openings in the pinyon/juniper belt as possible, in order to minimize well pad activities on migrating sage-grouse. This design strategy would aid in reducing stress to birds during their migration activities to wintering areas outside the Project Area. Further considerations for well pads in sage-grouse habitat would be coordinated between the Forest Service and the Operators prior to final well pad and access road layout. This coordination effort will further ensure that well pads and roads

built in sage-grouse habitat would be designed in a way so as to further minimize any impacts to sage-grouse habitat.

As there are no mitigations under Alternatives 2 and 3, Figure 5 depicts road and well pad disturbances in relation to sage grouse habitat under those alternatives. Figure 6 depicts sage grouse habitat with the 0.6 mile mitigation buffer. Well pad disturbance within sage grouse habitat and within the buffer would be restricted to one well pad/square mile (640 acres) under the mitigations for Alternative 4. Figure 6 also depicts the 0.6 mile buffer around leks. Under the mitigations for Alternative 4, there would be no surface disturbance within the 0.6 mile buffer.

Under the Proposed Action, 111 acres (5.3%) of sage-grouse habitat within the Project Area would be disturbed in addition to the 16 acres of existing disturbance (Table 3-35). Total disturbance within the DDCT area would be 249 acres (1.2% of habitat within the DDCT area) when added to existing disturbance (Table 3-36). Disturbance density would equate to 2.59, which is above the one disturbance/square mile threshold.

Disturbance associated with project activities within and adjacent to sage-grouse habitat, combined with the direct loss of sage-grouse habitat, would have direct and indirect impacts to the Anthro Mountain sage-grouse population. Well pad densities in sage-grouse habitat in the Antrho Mountain area would be approximately eight well pads per section, which would exceed the threshold for sage-grouse tolerance (one well pad per square mile). Disturbance associated with well pad construction, operation, and maintenance, including vehicular activity, noise, visual disturbance, and human activity, for wells in close proximity to leks could cause disruptions to sage-grouse activities during sensitive breeding and nesting periods. These disturbances in the absence of timing restrictions could cause decreased lek attendance, lek abandonment, displace sage-grouse from habitat in close proximity to well pad locations, reduce habitat quality, and create potential perching areas for raptors. There are two leks that are located along existing Forest Service system roads that would likely be used to access the Project Area on Wire Fence ridge. Using these roads as access would contribute to disturbance to nesting, breeding, brood rearing, and wintering birds. This could affect productivity of the population. These threats could contribute to population declines and ultimately impact the long-term viability of the Anthro Mountain population, particularly since the reduction in habitat quality and use has been documented to result in lower yearling recruitment, lower numbers of males using leks near natural gas development, reduced nesting success, and lower annual survival. In the absence of adequate mitigation to provide measures to reduce these direct and indirect impacts, it is determined that the Proposed Action would likely result in a trend to federal listing or loss of viability to the Anthro Mountain sage-grouse population.

Under Alternative 3, 117 acres (5.6%) of sage-grouse habitat within the Project Area would be disturbed in addition to the 16 acres of existing disturbance (Table 3-35). Due to the avoidance of slopes >25% in Alternative 3, roads have a slightly different alignment than Alternative 2, resulting in the extra 6 acres of sage-grouse impacts. Total disturbance within the DDCT area, including exiting and proposed, would be 255 acres (1.2% of habitat within the DDCT area; 6 more acres than the Proposed Action) (Table 3-36). Disturbance density would equate to 2.59, similar to the Proposed Action, which is above the one disturbance/square mile threshold.

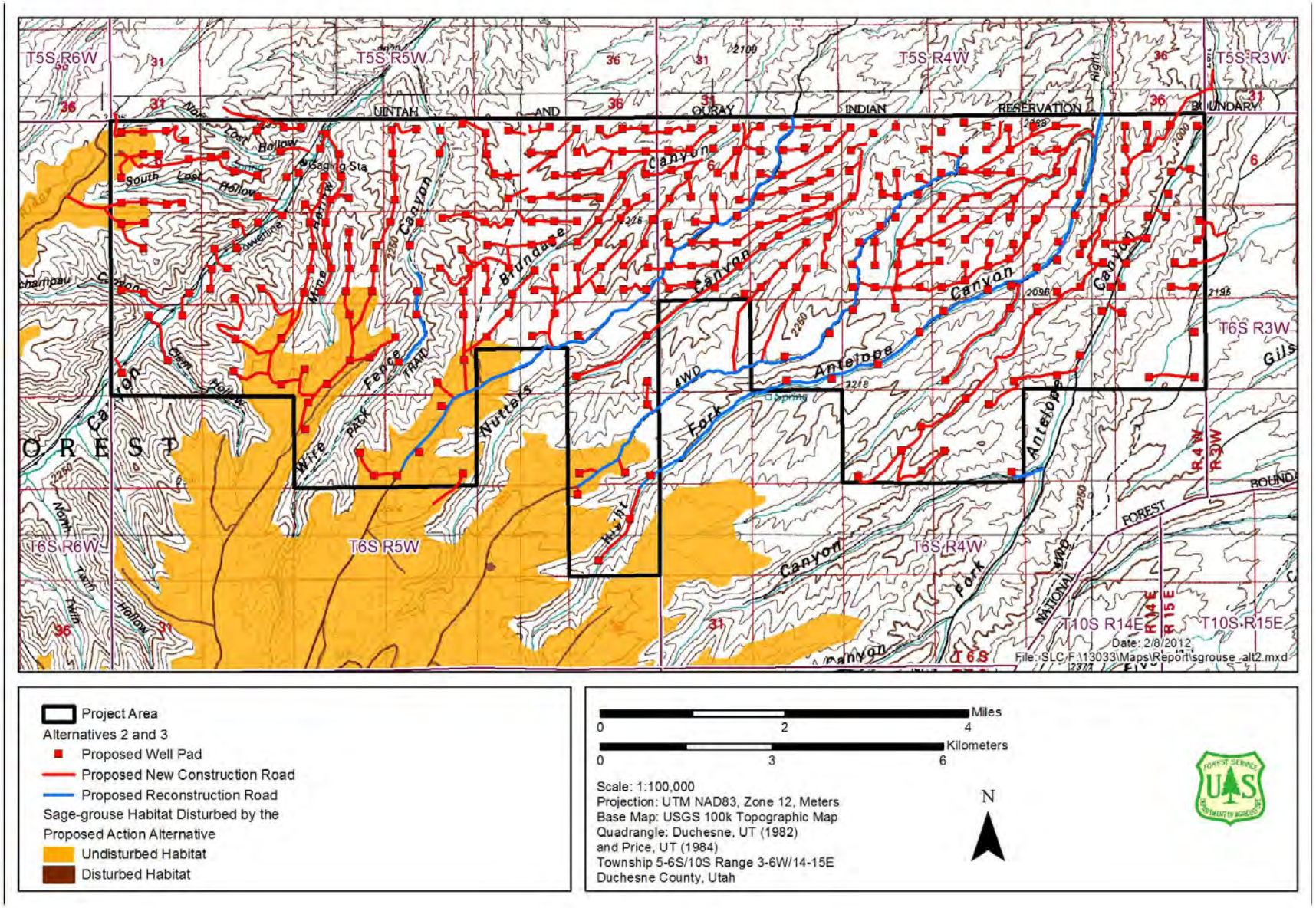


Figure 3-19. Alternatives 2 and 3 - Project Overlayed With Sage Grouse Habitat

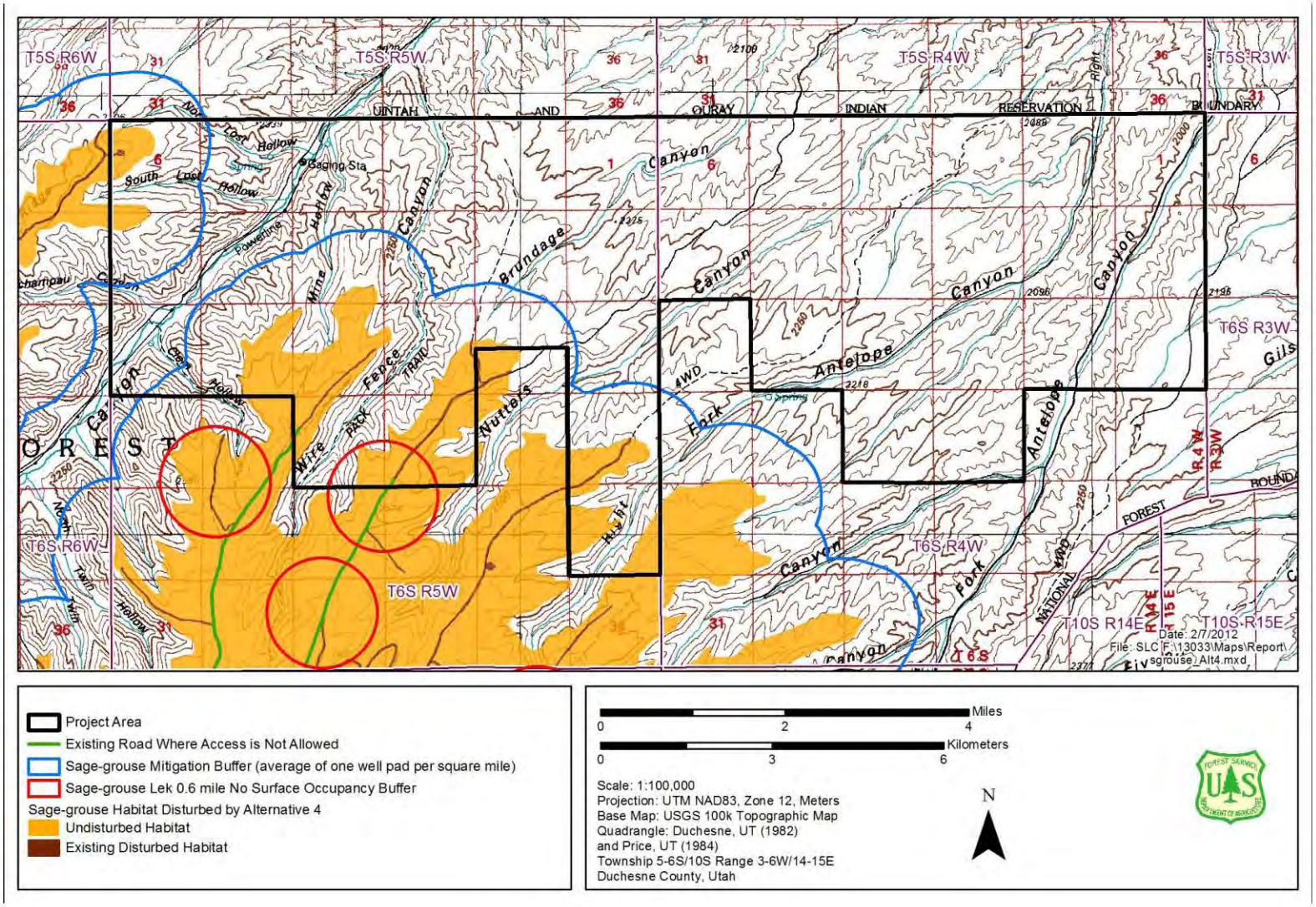


Figure 3-20. Alternative 4 Sage Grouse Mitigation Buffers - This map shows the area within 4 miles of a lek in which an average of one well pad/square mile would be applied (sage grouse habitat and 0.6 mile buffer of sage grouse habitat) and the 0.6 mile no surface occupancy buffer around leks.

Alternative 3 incorporates phased timing of operations to concentrate construction activities to specific portions of the Project Area within any given timeframe. In addition, mitigation associated with this alternative includes installing raptor perch avoidance devices and developing a specific POD to limit and/or mitigate sagebrush habitat fragmentation. However, habitat loss, well pad densities, and the indirect impacts associated with project activities are equivalent to those described under Alternative 2 and could result in the loss of population viability. Due to these impacts, in addition to the absence of adequate mitigation to provide measures to reduce those impacts, it is determined that Alternative 3 would likely result in a trend to federal listing or loss of viability to the Anthro Mountain sage-grouse population.

Without mitigations, Alternative 4 would disturb and additional 108 acres (5.1%) of sage-grouse habitat within the Project Area in addition to the 16 acres of existing disturbance (Table 3-35). Compared to Alternatives 2 and 3, Alternative 4 would result in less surface disturbance in sage-grouse habitat. Total disturbance within the DDCT area, would be 246 acres (1.2% of habitat within the DDCT area; 3 less acres than the Proposed Action) (Table 3-36). Disturbance density would equate to 1.78, which is 1.73, fewer disturbances per square mile than the Proposed Action, but greater than the one disturbance/square mile threshold.

Alternative 4 would be required to incorporate mitigation measures to provide additional protection to the Anthro Mountain sage-grouse population from direct and indirect activities associated with project operations. These mitigations were described in detail above, but the following is a summary.

The mitigations for this alternative would include spatial and timing restrictions, noise controls, measures to reduce visual impacts, and coordinated planning efforts between the ANF and the Operators of actual well pad and road design in sage-grouse habitat. These mitigation measures have been developed using research data collected on the Anthro Mountain sage-grouse population. In keeping with the DDCT approach, disturbance densities and sage-grouse habitat disturbance would not exceed thresholds that could be detrimental to sage-grouse population persistence and viability. These thresholds would include an average disturbance density of one well pad per square mile of sage-grouse habitat and no more than 5% of sage-grouse habitat being disturbed within the Project Area and within the DDCT analysis area. Therefore, actual disturbance would be lower than what is shown in Tables 3-35 and 3-36 with this mitigation measure.

Disturbance associated with project activities (maintenance, traffic, or work-over rigs) would be minimized by timing restrictions during the breeding, nesting, and wintering migration seasons. Timing restrictions in sage-grouse habitat during breeding seasons would minimize impacts to lek attendance and breeding behaviors. Timing restrictions in sage-grouse habitat during nesting season would minimize nest abandonment, maintain reproductive success, and prevent females from discontinuing breeding activities. Winter timing restrictions would be implemented along ridge tops within 4 miles of a lek to reduce disturbances of well pad construction, road construction, drilling activities, and traffic on migrating sage-grouse.

Permanent structures would be prohibited within 0.6 mile of lek sites to minimize noise, reduce visual impacts, maintain habitat quality, reduce traffic, and limit potential perching opportunities for raptors within close proximity to lek locations. Specific measures to minimize noise would include muffling well pads within 3.1 miles of a lek and orienting mufflers in a direction away from leks so as not to disturb strutting birds or cause lek abandonment. Specific measures to reduce the impacts of traffic, which include noise,

visual disturbances, potential threat of mortality through vehicular collisions, and reduction of habitat quality in areas adjacent to roads, on sage-grouse would include prohibiting project-related activities and vehicle access along Nutters Ridge Road and Wire Fence Ridge Road. Specific measures to reduce the threat of raptor predation would include installing raptor perch avoidance measures and the establishment of low-profile tanks for well pads within sage-grouse habitat.

Implementation of these mitigation measures under Alternative 4 would minimize or eliminate impacts to the Anthro Mountain sage-grouse population from the proposed project. Research has demonstrated that with the implementation of these measures, such parameters as lek attendance, lek abandonment, sage-grouse displacement from suitable habitats, yearling recruitment, nesting success, wintering survival, chick survival, and annual survival would be minimally affected. The maintenance of these population parameters, which have been identified as critical components in maintaining population viability, would therefore rely on the implementation of these mitigation measures.

Therefore, it is determined that the implementation of the proposed project with the mitigations under Alternative 4 may impact individuals but is not likely to cause a trend to federal listing or loss of viability to the Anthro Mountain sage-grouse population. Also, sagebrush communities across the Forest generally appear to be in good condition and do not appear to have been negatively affected by management actions (Goodrich 2008). Since, mitigations under Alternative 4 would not allow more than one well pad/square mile in sage grouse habitat, there would be considerably less disturbance to sagebrush than the 246 acres shown in the disturbance Table 3-36 (in the Alternatives section), and would be a small disturbance in proportion (<1%) to the amount of sagebrush contained within the Forest. Therefore, this small disturbance (< 1% of sagebrush on the Forest) is unlikely to affect the ability of the Forest to provide sagebrush habitat at the Forest-wide scale.

Flammulated Owl

Impacts to the flammulated owl would be considered substantial if more than 5% of the area within a 0.5-mile buffer surrounding known owl nests were impacted. If road construction, well pad development, habitat loss, and the indirect effects of these activities occurred within suitable coniferous and aspen forests, then nesting and foraging habitat for the flammulated owl would be modified.

Coniferous (Douglas-fir dominated) forest covers 310 acres and aspen forest cover 3 acres of the Project Area, totaling approximately 1% of the Project Area (Table 3-33). No surface disturbance would occur in these vegetation communities under any of the alternatives. Furthermore, no flammulated owls or flammulated owl nests were observed during focused surveys of the Project Area in July 2007 (SWCA 2007). Indirect effects from actions located near suitable habitat would be minimal. Timing restrictions for other migratory bird species could minimize these potential indirect effects.

Under Alternatives 2 and 3, no disturbance would occur within flammulated owl habitat and all of these areas would remain available for this species. Since no flammulated owl nests are known to occur within or near the project area, nesting owls are unlikely to be affected by the project. Some indirect impacts to this species would be possible due to truck traffic on the access roads (south of the Operators lease) at the top of Nutters and Wire Fence ridges which pass through aspen stands. However nesting flammulated owls have been documented to be tolerant of human and some mechanical activities and their response to such activities seem indifferent (USDA Forest Service 1994). Therefore,

flammulated owls are not likely to abandon nests or be displaced as a result of increased noise from roads. Therefore, the effects may impact individuals, but would not cause a trend toward the federal listing of the flammulated owl or cause a loss of viability to its population.

Under Alternative 4, no disturbance would occur within flammulated owl habitat, as in Alternatives 2 and 3. Sage-grouse mitigations under this alternative prevent the use of the access roads on Nutters and Wire Fence ridges (south of the Operators lease), which would eliminate any potential indirect impacts to flammulated owls or their habitat near those roads. Therefore, this alternative may impact individuals, but would not cause a trend toward the federal listing of the flammulated owl or cause a loss of viability to its population.

Northern Goshawk

Impacts to the northern goshawk would be considered substantial if more than 5% of the area within a 0.5-mile buffer surrounding known goshawk nests were impacted, or if the action alternatives are found to be out of compliance with the Goshawk Amendment to the Forest Plan. Potential impacts to goshawks include displacement and nest abandonment due to increased noise, increased vehicle collisions, and loss of foraging habitat and prey species. The degree of these impacts would also depend on the proximity of roads, wells sites, and human activities relative to goshawk nest sites. Northern goshawks are particularly sensitive to human disturbance during nesting activities, so construction, drilling, and/or completion activities surrounding goshawk nest localities would increase the risk of nest/brood abandonment by adult goshawks, leading to the loss of eggs or young. Because of the diversity of habitats used, and goshawks‘ sensitivity to nesting disturbances, impacts to goshawks are analyzed according to the amount of projected disturbance within a 30-acre buffer of known nest sites under each alternative (Forest Service 1999, 2000).

Although goshawks use a variety of forest types in the ANF, the majority of known breeding territories are in coniferous forests (Douglas fir, lodgepole pine, ponderosa pine, spruce, and subalpine fir). The limited amount and patchy distribution of this type of coniferous forest within the Project Area would not provide enough contiguous habitat for a goshawk territory. Some proposed access roads on Nutters and Wire Fence ridges (south of the Operators lease) would pass through aspen stands, which is another forest type used by goshawks for nesting and foraging. While it is possible that foraging goshawks may be impacted the chances are low as there are no known goshawk territories within or near these aspen stands or within or near the project area (Christensen 2011b). Also, these aspen stands are relatively small, which make them unlikely to be used by goshawks. The closest goshawk territory is 8+ miles to the southwest of the Project Area. If a nest is discovered in the Project Area, the Forest Service would enforce a 0.5-mile seasonal buffer (no human activities would occur within this buffer from March 1–September 15) and a 30 acre no surface disturbance buffer around the nest.

Since no disturbance to goshawk habitat would occur other than the use of some access roads through aspen forest, no nests or goshawk territories within or near the Project Area, seasonal and spatial buffers being placed around any newly discovered nests, and suitable foraging habitat acreage in the Project Area being low, it is determined that the proposed project under the action alternatives would comply with the intent of the Goshawk Amendment to the Forest Plan and would not cause a trend toward the federal listing of the northern goshawk or cause a loss of viability to its population. Additionally, under

Alternative 4, impacts to goshawk habitat would be less than in Alternatives 2 and 3. Sage-grouse mitigations under this alternative prevent the use of the access roads on Nutters and Wire Fence ridges (south of the Operators lease), which would eliminate potential indirect impacts in goshawk habitat (small aspen stands) along these roads.

American Three-toed Woodpecker

American three-toed woodpeckers occur in coniferous forests (Douglas fir dominated), which accounts for less than 1% of the Project Area. If surface disturbance occurred in this habitat type, then direct impacts could include the loss of nesting and foraging habitat, which may lead to the displacement of individuals. However, no surface disturbance would occur in this habitat type under any of the alternatives. Given the short-term nature of construction and drilling activities, the fact that no suitable coniferous forest would be disturbed under any of the alternatives, and the tolerance of three-toed woodpeckers to human activity (Leonard 2001), the limited amount of habitat within the project area, it is determined that the proposed project under the action alternatives would not cause a trend toward the federal listing of the American three-toed woodpecker or cause a loss of viability to its population.

Spotted Bat and Townsend's Big-eared Bat

Direct impacts to bats could occur at open contaminated-water impoundments associated with drilling operations (reserve pits) where bats could access toxic, contaminated water. However, this risk would be reduced by covering reserve pits with netting to prevent access by bats. There would be no impacts to caves.

As water sources (springs and Sowers Creek) are important to bats in this arid environment, these areas would need protection from project activities. Therefore, a 100 foot no surface disturbance buffer would be placed around all springs, and with the exception of stream crossings, a 150 foot buffer would be placed along Sowers Creek. Also, as there is a risk of contamination to bats from accessing contaminated water in reserve pits, netting would be required to be placed over these reserve pits to prevent contamination to both the spotted and Townsend‘s big-eared bats.

Impacts to the spotted bat are defined as the acres of disturbance to pinyon/juniper woodland, riparian, and sage habitats that provide foraging areas for this species. The layout of well pads and access roads would also increase the level of habitat fragmentation throughout the Project Area. Indirect impacts could include bats coming into contact with toxic and contaminated water as they forage over water impoundments associated with drilling operations (reserve pits). Table 3-37 provides a comparison of the number of acres of spotted bat potential foraging habitat directly impacted by each alternative. While the Proposed Action and alternatives could potentially result in direct and indirect adverse impacts to spotted bats, the probability is relatively low based on the percentage of potential foraging habitats of these wide-ranging bats that would be disturbed during the LOP.

Long-term disturbance to potential spotted bat foraging habitat (as defined by pinyon/juniper and sage [big sagebrush shrubland, black sagebrush, riparian, greasewood, and rabbitbrush] habitat) associated with the action alternatives would range between 1.8% and 2.3% of the 25,144 acres of available habitat within the Project Area. Given the short-term, temporary nature of well construction and drilling activities near suitable habitat (approximately 28 days), the small amount of habitat directly disturbed, habitat opportunity within the project area in the event that bats are temporarily displaced,

roosting areas not being disturbed, caves an hibernacula not occurring within the project area, and also given the water source protections stated above, it is determined that this Alternative may impact individual spotted bats, but would not cause a trend toward their federal listing or cause a loss of viability to their population.

Table 3-37. Surface Disturbance of Spotted Bat Potential Foraging Habitat within the Project Area.

Surface Disturbance	Alternative 1 (No Action)	Alternative 2 (Proposed Action)	Alternative 3	Alternative 4
Acres of short-term disturbance[1]	0	1,326	1,316	807
Acres of long-term disturbance[2]	0	579	579	446
Percent of Project Area habitat disturbed[3]	0	2.3	2.3	1.8
Percent CIAA habitat disturbed[4]	0	1.1	1.1	0.8

[1] Short-term disturbance includes those acres disturbed during drilling and completion phases.
[2] Long-term disturbance includes those acres disturbed after interim reclamation.
[3] Percent of long-term disturbance to pinyon/juniper, riparian, and sage (big sagebrush shrubland, black sagebrush, greasewood, and rabbitbrush) habitats (25,144 acres).
[4] Percent of long-term disturbance to available habitat in the CIAA/Forest Service analysis area (54,147 acres).

Since Townsend‘s big-eared bats may use a variety of habitats across the Project Area, impacts are defined as the acres of disturbance to coniferous, deciduous, riparian, and pinyon/juniper habitat that provide foraging areas for this species. Table 3-38 provides a comparison of the number of acres of Townsend‘s big-eared bat potential foraging habitat directly impacted by each alternative. While the Proposed Action and alternatives could potentially result in direct and indirect adverse impacts to Townsend‘s big-eared bats, the probability is relatively low based on the percentage of potential foraging habitats of these wide-ranging bats that would be disturbed during the life of the project. The layout of well pads and access roads would also increase the level of habitat fragmentation throughout the Project Area. Long-term disturbance to potential Townsend‘s big-eared bat foraging habitat (as defined by pinyon/juniper, coniferous forest, aspen forest, and riparian habitat) associated with the action alternatives would range between 1.5% and 2.1% of the habitat within the Project Area.

Since Townsend‘s big-eared bats have not been found in the Project Area and since there are no caves for hibernacula or roosting within or near the Project Area, it is reasonable to assume that the likelihood of any of the described impacts actually affecting a Townsend‘s big-eared bat is low. Also, given the short-term, temporary nature of well construction and drilling activities near suitable habitat (approximately 28 days), the small amount of habitat directly disturbed, habitat opportunity within the project area in the event that bats are temporarily displaced, caves (hibernacula and roosting habitat) not occurring within the Project Area, and also given the water source protections stated above, it is determined

that the Action Alternatives may impact individual Townsend‘s big-eared bats, but would not cause a trend toward their federal listing or cause a loss of viability to their population.

Table 3-38. Surface Disturbance of Townsend‘s Big-eared Bat Potential Habitat within the Project Area.

Surface Disturbance	Alternative 1 (No Action)	Alternative 2 (Proposed Action)	Alternative 3	Alternative 4
Acres of short-term disturbance[1]	0	1,024	979	582
Acres of long-term disturbance[2]	0	443	452	331
Percent of Project Area habitat disturbed[3]	0	2.0	2.1	1.5
Percent CIAA habitat disturbed[4]	0	0.4	0.4	0.3

[1] Short-term disturbance includes those acres disturbed during drilling and completion phases.

[2] Long-term disturbance includes those acres disturbed after interim reclamation.

[3] Percent of long-term disturbance to available coniferous forest, aspen forest, pinyon/juniper, greasewood and riparian habitats in the Project Area (22,359 acres).

[4] Percent of long-term disturbance acreage to available habitat in the CIAA/Forest Service analysis area (113,237 acres).

3.9.2.3 Cumulative Impacts

The CIAA for all Forest Service sensitive species, except sage grouse, is the Forest Service Analysis Area (FSAA), a total area of 186,923 acres. This CIAA/FSAA is bounded by Highway 191 to the west, the First Standard Parallel to the north, Wells Draw road to the east, and Five Mile Canyon Road and the southern Forest boundary of the South Unit on the south. This area was selected as the CIAA, because it is large enough to capture effects that may cumulatively affect wildlife on Forest Service lands (portion of the South Unit east of Hwy 191) as well as those impacts to wildlife on adjacent lands BLM and Tribal lands surrounding the Forest and the Project Area. The term ―wildlife” below refers to sensitive species, except sage grouse.

Impacts from past, present and RFAs regarding energy development projects would be similar to the impacts from this proposed project. However, there is very little typical flammulated owl, three-toed woodpecker, or goshawk habitat on lands adjacent to the Forest Service within the CIA. Also, no surface disturbance would occur in these species habitat within the Project Area. Some pockets of aspen are located on the Forest south of the project area in sage brush communities. It is likely that combining the project with any oil and gas development in this area (Vantage), if any occurs in the future, would have similar mitigations as described under Alternative 4 in the sage grouse section. This would minimize impacts to the flammulated owl and goshawk if they happen to occur in the area in the future. For activities on Forest Service lands, surface use and seasonal restrictions around northern goshawk nests would be enforced, thus complying with the standards and guidelines in the Forest Plan. Bats may be cumulatively impacted by reduced foraging

habitat from direct disturbance as well as indirect effects of weed proliferations. However, it is assumed that spotted bats will likely be displaced by some distance from human activities associated with the this project and similar project within the CIAA, but that greater impacts to bats would come from the amount of habitat actually impacted by vegetation removal, and from disturbance to water sources and roosting habitat. These cumulative impacts are unlikely to affect any cliffs that may occur within the CIA. Therefore roosting habitat is not expected to be affected. Also, there would be a very small percentage of habitat affected by surface disturbance (refer to direct and indirect effects) from the Project. Additionally, there are mitigations to protect riparian within the project area to minimize impacts of the project. Therefore, impacts to bat habitat would be minimized. As riparian is commonly valued, it is reasonable to assume that riparian areas elsewhere in the CIAA would also be protected from oil and gas development.

RFAs that could impact these species include recreation, livestock grazing, and wildlife habitat management. Recreation impacts include hunting, camping, and firewood gathering. As the project is unlikely to increase recreation activities, it is likewise unlikely to increase impacts to wildlife when combining the project with recreation activities. Past, present, and RFAs for wildlife habitat improvement projects include prescribed burns and conifer encroachment projects. Prescribed burns within the CIAA include two projects totaling 3,200 acres; approximately 1,150 of the 1,200 acres of the Anthro Mountain target area have already been completed and no areas have been treated within the Antelope Canyon prescribed burn area. These burn areas are targeting dense sagebrush habitats (including isolated stands of aspen) with a canopy cover greater than 20%. Conifer encroachment projects that have occurred and are proposed to occur within the CIAA consist of mechanical treatments to deter the encroachment of pinyon, juniper, and Douglas-fir trees into shrub communities. These projects may cause some temporary disturbance to wildlife, but the long term results would benefit most wildlife species. Therefore combining these habitat projects with the proposed project is unlikely to have negative effects to wildlife. The CIAA also contains almost 95,000 acres of cattle grazing allotments. Cattle grazing activities associated with these allotments may reduce available forage and cover, reduce nesting habitat, impact riparian areas, reduce prey species, and displace wildlife. However, grazing allotments on the Forest take wildlife needs into consideration and ensure there is a residual amount of forage for wildlife. Therefore, there would be minimal impacts to wildlife, when grazing is combined with the project.

Based on the above rationale and mitigations with the project, especially mitigations under Alternative 4, it is determined that combining cumulative impacts with project may impact individuals of sensitive species, but would not cause a trend toward the federal listing of these species (three-toed woodpecker, flammulated owl, goshawk, spotted bat, Townsend‘s big-eared bat) or cause a loss of viability to their populations.

The CIAA for greater sage-grouse is the DDCT analysis area. Nearly all the Sage grouse habitat within the DDCT occurs on Forest Service lands. This area contains habitat (breeding, nesting, brood rearing, simmering, and wintering) that supports the Anthro Mountain sage-grouse population and thus represents a suitable area within the ANF South Unit boundary for which to assess cumulative impacts. The project Area encompasses approximately 10% of the DDCT area. Direct habitat disturbance associated with the alternatives would reduce available habitat for sage-grouse within the DDCT, and would create a total disturbance within the DDCT of 246 acres to 255 to acres depending on the alternative (Table 3-36).

The DDCT analysis also calculated disturbance on a cumulative level. This cumulative analysis included the Vantage Energy proposals (discussed in Section 4.3) that are still under review by the Forest Service. It is estimated that these possible future disturbances would add an additional 7 acres of disturbance to sage grouse habitat and an additional 3 disturbance activities within the DDCT. These additional disturbances would still be within the range of acceptance (level of tolerance to disturbance exhibited by sage grouse) described in the DDCT analysis. According to the DDCT, there could only be a total of 24 additional disturbances within sage grouse habitat. The three possible future disturbances proposed by Vantage Energy would count as part of the 24 allowed.

Two of these proposed Vantage Energy well pads (under review by the Forest Service) are located in sage grouse habitat on Wild Horse ridge which is separated (by Sowers Canyon) from habitat primarily used by the population. These two proposed well pads may not disturb sage grouse as much as the third Vantage proposed well pad. This third well pad that is still under review by the Forest Service is located in primary habitat used by sage grouse. Vantage Energy has also proposed (still under review by the Forest Service) production of two existing well pads within primary habitat used by sage grouse. These two existing well pads were included in the existing disturbance calculation of the DDCT. Although these two well pads were included in the DDCT calculation, production activities would produce additional disturbances (noise, traffic, etc.) to sage grouse that do not currently exist. Although the Vantage proposal is still under review, mitigations similar to those under Alternative 4 would likely be needed to protect sage grouse and primary sage grouse habitat. Therefore with these mitigations, impacts to the Anthro Mountain sage-grouse population would be minimized, since research has demonstrated that with the implementation of these measures sage grouse would be minimally affected. Past, present, and RFFA energy development projects as well as other actions related to mineral extraction, road construction, recreation, wildlife improvement projects, and livestock grazing, would be similar to the impacts from this project and would include increased predation pressures, nesting, brood rearing, and winter habitat loss, habitat fragmentation, increased impacts to lek sites through the presence of traffic, human activity, and noise, decreased nest success due to increasing energy development activities, increased exposure to West Nile virus, and lowered recruitment which could ultimately pose a significant risk to the Anthro Mountain sage-grouse population.

Greater sage-grouse in the CIAA would be affected by the cumulative removal of sagebrush habitat used for nesting, brood-rearing, and wintering habitat. However, habitat improvement projects within the CIAA, such as prescribed burns, conifer encroachment projects, and grazing manipulations would improve sagebrush habitat. Prescribed burns within the CIAA include two projects totaling 3,200 acres; approximately 1,150 of the 1,200 acres of the Anthro Mountain target area have already been completed and no areas have been treated within the Antelope Canyon prescribed burn area. These burn areas are targeting dense sagebrush habitats (including isolated stands of aspen) with a canopy cover greater than 20%. These management actions that result in small, patchy burns may improve brood-rearing habitat for the Anthro Mountain population. Anthro sage grouse hens have been documented using these small patchy burns for brood rearing. Conifer encroachment projects that have occurred and are proposed to occur within the CIAA consist of mechanical treatments to deter the encroachment of pinyon, juniper, and Douglas-fir trees into shrub communities. These treatments would maintain habitat for sage grouse, by removing the encroaching conifers from the sagebrush community. Range improvements being proposed within the CIAA include waterlines, fencing, and troughs and include the Brundage, Twin Hollows, and Sowers Canyon range improvement areas.

Water improvements may also be a benefit sage grouse by providing additional water sources. The CIAA also contains almost 95,000 acres of cattle grazing allotments. Cattle grazing activities associated with these allotments may reduce available forage and cover, reduce nesting habitat, impact riparian areas, reduce prey species, and displace wildlife. However, the allotments that overlap sage grouse habitat are managed to leave a residual amount of forage and cover for wildlife. A study to evaluate the response of vegetation and sage-grouse to high-intensity short-duration grazing is currently being conducted on Anthro Mountain.

Telemetry has shown that Anthro sage grouse have several wintering areas. Some birds stay on Anthro Mountain (sage grouse habitat within the DDCT) to winter, and others migrate to lower elevations and mingle with other sage grouse populations (Christensen 2011a). These lower elevation wintering areas include Emma Park, Big Wash/Sand Wash, and Lower Cottonwood Ridge. These wintering areas largely occur on BLM, Private, State, and some tribal lands. Oil and gas development is occurring on some portions of these wintering areas. Expansion of oil and gas development within these wintering areas could increase impacts to wintering sage, including wintering sage grouse from Anthro. This is likely to increase winter habitat loss and disturbance density in wintering areas, which could impact sage grouse within the wintering areas that experience these impacts. However, the new BLM Interim Policies and Procedures for Sage Grouse directs the protection of sage grouse (USDI BLM 2011). This Interim Policy directs the protection of unfragmented habitats; directs the minimization of habitat loss and fragmentation; and directs maintenance, restoration, and enhancement of conditions to meet sage grouse life history needs (USDI BLM 2011). Specifically to fluid minerals (oil and gas) the Policy directs evaluation of impacts and the development of measures to minimize impacts to sage grouse and sage grouse habitat (USDI BLM 2011). This Interim Policy to protect sage grouse will be in effect until local Management Plans have developed protection measures for sage grouse (USDI BLM 2011). Since the intent of this direction is to protect sage grouse and sage grouse habitat, it is likely that the wintering areas that are used by the Anthro population would be given higher consideration for protection. This is likely to minimize future impacts to these wintering areas and thereby minimize impacts to wintering sage grouse.

Combining these cumulative impacts with Alternatives 2 and 3 is likely to have adverse affects to the Anthro sage grouse population, since these Alternatives do not provide adequate measures to minimize impacts to sage grouse. However, Alternative 4 provides mitigations to protect sage grouse and sage grouse habitat and minimizes impacts that could otherwise occur. Therefore, based on the above discussion of cumulative impacts and the discussion and mitigations for Alternative 4, it is determined that the project under Alternative 4 combined with the cumulative impacts may impact individuals but is not likely to cause a trend to federal listing or loss of viability to the Anthro Mountain sage-grouse population. This population has experienced fluctuations in numbers over time with a recent decline. However, as discussed above in the Population Status Section, these fluctuations are Region-wide, and since only 10% of sage grouse populations in the Northeast Region occur on the Forest, it is likely that the fluctuations are caused by some other factor than management actions on the Forest such as weather and predation (Christensen 2011, Forest Service 2006a). Therefore, based on the sage grouse discussion in this Report, it is likely that the project (under Alternative 4 and accompanying mitigations) combined with the cumulative impacts would not have much influence on sage grouse population trends Forest-wide or Region-wide. Additionally, since mitigations (one well pad/square mile) under Alternative 4 would decrease disturbance in sagebrush,

there would be less disturbance than is shown in Table 3-35. Also, sagebrush communities across the Forest generally appear to be in good condition and do not appear to have been negatively affected by management actions (Goodrich 2008). Since, mitigations under Alternative 4 would not allow more than one well pad/square mile in sage grouse habitat, there would be considerably less disturbance to sagebrush than the 246 acres shown in Table 3-36 and would be a small disturbance in proportion (<1%) to the amount of sagebrush contained within the Forest. Therefore, this small disturbance (< 1% of sagebrush on the Forest) combine with cumulative impacts is unlikely to affect the ability of the Forest to provide sagebrush habitat at a Forest-wide scale.

3.9.2.4 Mitigation

Flammulated Owl and American Three-toed Woodpecker

No mitigation measures are required for the flammulated owl and American three-toed woodpecker.

Northern Goshawk

If a goshawk nest is discovered within the Project Area, the following mitigation measures would be implemented:

- Within a 0.5-mile buffer of an active nest, restrict activities and human uses during the active nesting period (March 1–September 15) unless it is determined that the disturbance is not likely to result in nest abandonment.
- No surface disturbance would be allowed within a 30 acre buffer of a nest.

Spotted Bat and Townsend's Big-eared Bat

- All open contaminated-water impoundments associated with drilling operations (such as reserve pits) located in spotted bat and Townsend‘s big-eared bat foraging habitats would be covered with netting to prevent access by bats to toxic and contaminated water.
- To protect water sources for spotted bats, a 100 foot no surface disturbance buffer would be placed around all springs, and a 150 foot buffer would be placed along each side of Sowers Creek for well pads and roads, with the exception of stream crossings.

Greater Sage Grouse

The below mitigations apply to Alternative 4. These mitigations are necessary to avoid adverse impacts to the Anthro Sage grouse population.

- To reduce potential disturbance to strutting birds (subsequently the likelihood of lek abandonment) nesting birds, and habitat disturbance, no well pads or permanent structures will be allowed within 0.6 mile of an occupied lek. This measure would distance structures away from leks that raptors may use for perching.
- To reduce potential disturbance to strutting birds and subsequently the likelihood of lek abandonment, timing restrictions will be required during the breeding season (March 1–May 31) within sage-grouse habitat, and within 0.6 mile of sage-grouse habitat. No project-related vehicles or activities (including routine maintenance, production vehicles, or work-over rigs) will be allowed, from 1 hour before sunrise to 3 hours after sunrise, and from 2 hours before sunset to 1 hour after sunset.

- From March 1 through June 30, no surface-disturbing activities (including construction, drilling, and well flaring) will be allowed for wells located within sage-grouse habitat in order to protect nesting sage-grouse.
- To avoid disruption of sage-grouse migration activities, no well pad construction, road construction, drilling, or work-over rigs will be allowed on ridge tops from November 15 to March 1 within 4 miles of a lek.
- Within 4 miles of a lek, sage grouse habitat will be buffered by 0.6 mile. Within this buffer well pad construction will not exceed an average of one well pad/square mile (640 acres). This mitigation will be applied to the Project Area. Additionally, no more than 5% of sage grouse habitat is allowed to be disturbed within the Project Area. This will reduce the amount of disturbance to sage grouse and maintain the one disturbance/square mile threshold.
- The Anthro Mountain telemetry study has shown that sage-grouse may be using openings in pinyon/juniper during migration events. Therefore within 4 miles of a lek, in openings of the pinyon/juniper (chained or natural openings in pinyon/juniper belt), well pads should be located as close to the edge of the opening as possible.
- To reduce noise levels down to an acceptable level so as not to disturb strutting birds or cause lek abandonment, all wells within 3.1 miles of a lek will be muffled with the latest technology to reduce noise levels from wells down to no more than 45dB at a lek. All wells within 3.1 miles of a lek will have mufflers oriented away from leks.
- To reduce the vantage point that raptors might have by perching on new structures, low-profile tanks will be required for all well pads within sage-grouse habitat.
- Project-related activities and vehicle access will not be allowed on the Nutters Ridge Road (FSR 333) or the Wire Fence Ridge Road (FSR 332), south of the Operator‘s current lease area. This will prevent disturbance to breeding, nesting, brood rearing, and wintering sage grouse that might otherwise occur if access along these roads were permitted.

3.9.2.5 Management Indicator Species

Impacts Common to all Alternatives

Impacts to MIS habitat would occur in various forms, including 1) an increase in habitat loss/fragmentation, 2) a reduction in habitat quality/value, and 3) a change in wildlife habitat use. The construction of road/pipeline ROWs, well pads, and associated facilities would impact wildlife with respect to the direct loss of habitat, and contribute to habitat fragmentation through the increase in road density, an increase in habitat patches/fragments, a reduction in habitat patch size, and reduced distances to roads and other infrastructure (i.e., less area removed from indirect impacts of construction, development, and production activities). Indirect effects would also extend beyond the footprint of the road, and the utilization of habitats adjacent to such infrastructure would be affected due to the presence of human activities, noise, and potentially perceived visual threats. Indirect effects could also reduce the quality of habitat adjacent to the road, particularly due to forage quality.

Habitat fragmentation may be less obvious than direct impacts such as vehicle collisions with wildlife or vegetation removal, which may include the loss of available habitat used for foraging, nesting, and shelter, but often carries considerable consequences for long-term population and reproductive success. The creation of new roads fragments wildlife

habitat and creates a network of habitat patches across the landscape and may isolate species or displace travel routes to other locations (Dobson et al. 1999). Displaced individuals may exert more energy to find suitable movement routes and activity areas that may result in wildlife altering habitat selection by seeking less favorable areas to forage and breed (Sawyer et al. 2006). Vehicular traffic and associated noise may further displace animals from the roadway. Traffic patterns, vehicle type, and vehicle speed may affect how wildlife movements are restricted or displaced across roadways. Increased mortality from animal/vehicle collisions is a potential direct impact that may occur due to increased traffic within the Project Area and along access roads. Noise from traffic may also create a buffer zone that displaces animals at further distances from the roadway. This ―edge effect" may also represent less suitable habitat due to the presence of invasive plant and animal species that utilize roads as conduits for dispersal. New roads can increase access to big game ranges that may in turn increase harvest rates, legal or illegal. Alternatively, some people may be deterred from legal hunting activities due to the perceived decrease in quality of experience created by development activities; poachers may be deterred because of the greater access and likelihood of being observed. Environmental consequences for greater sage-grouse are discussed in Section 3.9.2.2.

Impacts to the following MIS would be considered substantial if:

- well densities exceeded over four well pads per section within mule deer and elk crucial winter ranges (Wyoming Game and Fish Department [WGFD] 2004);
- surface disturbance was greater than 5% of the area within a 0.5-mile buffer surrounding known raptor nests; or
- activities adversely affect the ability of the forest to provide habitat for migratory birds, including raptors.
- surface disturbance was greater than 5% of the area within a 0.5-mile buffer surrounding known raptor nests; or

Mule Deer

Threats to mule deer from oil and gas development include the long-term loss of forage and cover, and reduced habitat quality due to roads, accumulations of dust from roads on vegetation, and well pads for the life of the project. Loss of habitat would result in the displacement of mule deer from disturbed areas to surrounding, less-disturbed areas. Loss of mule deer habitat value would also result from project activities including increase in human activities and noise levels. Mule deer may avoid areas where noise and human presence are elevated compared to surrounding areas and previous points in time. 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.

The WGFD (2010) states that impacts from well pad densities between 5 to 16 well pads per square mile on mule deer crucial winter ranges are considered ―High‘ and impacts could be increasingly difficult to mitigate and may not be completely offset by management and habitat treatments. Impacts from well pad densities of four or less per square mile on mule deer crucial ranges are considered ―Moderate‘ and impacts could be minimized or avoided through effective management practices and habitat treatments. Some individual animals can ―habituate" to the increased infrastructure; however, it is generally assumed that, overall, the increased human presence in an area is detrimental to

big game species. Although studies can measure the spatial and temporal displacement of ungulates relative to energy exploration, development, and production activities, little information is available concerning how human-related disturbances impact reproduction and survival of ungulates (Western EcoSystems Technology Inc. 2003). WGFD also recommends keeping well pad density to four well pads per square mile in migration corridors wider than 0.5 mile; corridors less than 0.5 mile wide should avoid surface disturbance (WGFD 2010).

The Table 3-39 provides the acres of surface disturbance to mule deer habitat by alternative within the Project Area and within the Forest Service Analysis Area. There are 186,923 acres of mule deer habitat within the Forest Service Analysis Area, but only 170,122 of those acres are considered crucial deer habitat or substantial deer habitat. All of the Project Area (approximately 25,913 acres) is considered either crucial or substantial deer habitat, and the tables below reflect those acreages.

Table 3-39. Acres of Surface Disturbance (and Percentage of Total Designated Habitat) to Mule Deer Habitat by Alternative.

	Acres within Project Area (FSAA)	Existing Disturbance	Alternative 1 (No Action)	Alternative 2 (Proposed Action) [1]	Alternative 3[1]	Alternative 4[1]
Crucial summer range	1,975 (30,297)	11 (0.5%, 0.04%)	0	54 (2.7%, 0.2%)	56 (2.8%, 0.2%)	55 (2.8%, 0.2%)
Crucial winter range	598 (39,421)	6 (1.0%, 0.02%)	0	37 (6.2%, 0.1%)	37 (6.2%, 0.1%)	16 (2.7%, 0.04%)
Substantial winter range	23,340 (100,404)	141 (0.6%, 0.14%)	0	1,270 (5.4%, 1.3%)	1,261 (5.4%, 1.3%)	765 (3.3%, 0.8%)
Total	**25,913 (170,122)**	**158 (0.6%, 0.1%)**	**0**	**1,361 (5.3%, 0.8%)**	**1,354 (5.2%, 0.8%)**	**836 (3.2%, 0.5%)**

[1] Total acres of surface disturbance and (in parentheses) percent of crucial/substantial habitat disturbed. First value represents the percentage of the disturbance acres to the total crucial or substantial habitat within the Project Area; second value represents the percentage of the disturbance acres to the total crucial or substantial habitat within the Forest Service Analysis Area.

Sawyer et al. (2006) found that mule deer preferentially use habitat where road densities are ≤0.16 km/km2 in a natural gas field in western Wyoming. For the purposes of this analysis, all habitats where road density would exceed 0.16 km/km2 would be considered unfavorable. Table 3-40 below shows the results of the analysis and remaining favorable habitat.

Currently mule deer use nearly all habitats within the Project Area. However, the analysis shows existing roads rendering 16,901 acres (65%) of mule deer habitat in the Project

Area as currently ~~"u~~nfavorable" due to habitat fragmentation. This discrepancy is likely explained by the low level of traffic and noise disturbance that currently occurs on these roads, which exhibit a lower degree of avoidance by mule deer than what the analysis depicts for existing conditions. As the additional roads created for the project would likely receive a higher degree of traffic and noise disturbance (from construction, drilling, and continual traffic of trucks during the production phase) than currently occurs on existing roads, the analysis will serve to explain the potential changes of mule deer habitat to unfavorable amongst alternatives.

Table 3-40. Road Density in Mule Deer Habitat by Alternative.

	Existing Conditions	Alternative 1 (No Action)	Alternative 2 (Proposed Action)	Alternative 3	Alternative 4
Total miles of road[1]	39	39	116	114	96
Acres of favorable mule deer habitat (road density ≤0.16 km/km^2)	8,999	8,999	684	741	938
Percent of available habitat in Project Area that is favorable[2]	35%	35%	3%	3%	4%

[1] Includes existing maintained roads, upgraded roads, and new roads. Does not include existing two-track roads that would not be upgraded.

[2] available habitat in Project Area = 25,913 acres

Alternative 2

Under Alternative 2, 1,270 acres (5.4%) of mule deer substantial winter range within the Project Area would be directly disturbed (Table 3-39). The largest proportion of habitat disturbed would be crucial winter range (37 acres; 6.2%); 54 acres (2.7%) of crucial summer range would be disturbed. These two ranges occur in the extreme northern (crucial winter range) and southern (crucial summer range) portions of the Project Area and represent a small portion of much larger ranges that extend to the north and south. In total, 1,361 acres of habitat would be impacted, which would account for 5.3% of the Project Area. Disturbance would not exceed 1.3% of any crucial or substantial range within the Forest Service Analysis Area. The 1,361 acres of habitat impacted represents 0.8% of the available range in the Forest Service Analysis Area.

There would be 77 miles of new road constructed within the Project Area, for a total of 116 miles of roads (Table 3-40). This increase in road density throughout the Project Area would reduce favorable mule deer habitat in the Project Area to 684 acres (3% of available habitat). Therefore, 97% of the mule deer habitat would be considered unfavorable (i.e., road density >0.16 km/km2). This would be a 32% increase of unfavorable habitat in the Project area from existing conditions. Road densities are lower within the non-project portion of the Forest Service Analysis Area and deer may move into those more favorable areas.

To reduce disturbances to mule deer winter timing stipulations would be enforced, guzzlers would be moved away from well pads, and springs and Sowers Creek would be protected by a buffer (mitigations for bats and sparrows). However, disturbance associated with project activities within and adjacent to mule deer crucial habitats, combined with the direct loss of mule deer crucial habitat, increased road densities, a 32% increase of unfavorable habitat in the project area, the project rendering a total of only 3% of the project area in favorable mule deer habitat, and higher well pad densities (up to 16 well pads per square mile) would have direct and indirect impacts to mule deer within the project Area. In the absence of adequate mitigation to provide measures to reduce these direct and indirect impacts, it is determined that a large portion of the Project Area may become unfavorable to mule deer and this may cause mule deer to avoid the area. This would likely decrease the number of mule deer that the Forest Service Analysis Area could support.

Although the project may decrease deer numbers on the Forest Service Analysis Area, it is unlikely to substantially decrease deer numbers within the Anthro Herd Unit. The worst case scenario would be that crucial and substantial mule deer habitat within the Project Area would no longer be available to mule deer. The project area (approximately 25,913 acres) is only 15% of crucial and substantial mule deer habitat in the Forest Service Analysis Area (170,122 acres described in the Introduction to Environmental Consequences). Also, the Project Area is only 4% of the Anthro Herd Unit (639,228 acres – boundary described at the beginning of the Cumulative Impacts Section). Based on these percentages, it is unlikely that changing only 4% of the Anthro Deer Herd Unit to an unfavorable condition for mule deer would equate to a substantial decrease (20%) in mule deer numbers within the Herd Unit. Furthermore, the Anthro Herd Unit has experienced a slight increasing trend in the mule deer population the last 6 years. It has increased from 3,950 deer in 2005 to 4,600 deer in 2010 (UDWR 2006b, Christensen 2011b). This current trend further reduces the likelihood of the project substantially decreasing the deer population in the Herd Unit. Also, fawning habitat is not a limiting factor to deer populations on the Forest and a reduction in fawning habitat would not have as much affect to deer as would the reduction in –crucial" winter habitat.

Looking at the discussed impacts to deer from the project under at the larger Forest-wide scale it is unlikely that the project under this alternative would have much decrease to mule deer populations Forest-wide. The Forest overlaps 4 other Deer Herd Units, and contains 1,384,132 acres, of which nearly all is considered mule deer habitat (Forest Service 2006a). If the impacts from the project render the 25,913 acre Project Area unfavorable to mule deer, that would equate to less than a 2% loss of mule deer habitat Forest-wide.

Based on the analysis, discussion above, and discussion in the MIS Report (prepared for this project), it is determined that the project under Alternative 2 may render the Project Area unfavorable to deer, may decrease deer numbers on the Forest Service Analysis Area, and possibly decrease deer numbers on the Anthro Herd Unit, but is unlikely to substantially decrease mule deer numbers on the Anthro Herd Unit. It is further determined that although the project under Alternative 2 may possibly result in a decrease in deer numbers at the local population level, it is unlikely to have much effect to the trend in the deer population at the Forest-wide scale or much effect on the ability of the Forest to provide habitat for mule deer Forest-wide.

Alternative 3

Under Alternative 3, there would be the same impacts to deer as was described under Alternative 2, with the following exceptions. Under Alternative 3, there would be 1,261 acres (5.4%) of mule deer substantial winter range within the Project Area would be disturbed (Table 3-39). This amount is 9 acres less than the disturbance to substantial winter range for the Proposed Action. The largest proportion of habitat disturbed would be crucial winter range (37 acres; 6.2%); 56 acres (2.8%) of crucial summer range would be disturbed. These two ranges occur in the extreme northern (crucial winter range) and southern (crucial summer range) portions of the Project Area and represent a small portion of much larger ranges that extend to the north and south. In total, 1,354 acres of habitat would be impacted, which would account for 5.2% of the Project Area. Total disturbance is 7 acres less than the total disturbance for the Proposed Action. Disturbance would not exceed 1.3% of any crucial or substantial range within the Forest Service Analysis Area. The 1,354 acres of habitat impacted represents 0.8% of mule deer crucial or substantial range in the Forest Service Analysis Area.

75 miles of new road that would be constructed within the Project Area, for a total of 114 miles of roads. This increase in road density throughout the Project Area would reduce favorable mule deer habitat in the Project Area to 684 acres (3% of available habitat), similar to the Proposed Action. Road densities are lower within the non-project portion of the Forest Service Analysis Area and deer may move into those more favorable areas.

Although Alternative 3 incorporates phased timing of operations to concentrate construction activities to specific portions of the Project Area within any given timeframe, additional BMPs are proposed to drill multiple wells from a single well pad and centralize production facilities where possible to lower traffic along roads. However, although these measures each contribute to reduced indirect impacts to mule deer; crucial habitat loss, road densities, and well pad densities are equivalent to those under Alternative 2. Therefore, Alternative 3 would likely result in the same impacts as is described in Alternative 2.

Based on this discussion and on the discussion under Alternative 2, it is determined that the project under Alternative 3 may render the Project Area unfavorable to deer, may decrease deer numbers on the Forest Service Analysis Area, and possibly decrease deer numbers on the Anthro Herd Unit, but is unlikely to substantially decrease mule deer numbers on the Anthro Herd Unit. It is further determined, based on the discussion under Alternative 2, that although the project under Alternative 3 may possibly result in a decrease in deer numbers at the local population level, it is unlikely to have much effect to the trend in the deer population at the Forest-wide scale or much effect on the ability of the Forest to provide habitat for mule deer Forest-wide.

Alternative 4

Under Alternative 4, impacts to mule deer would be the same as Alternatives 2 and 3, but to a lesser degree. Under Alternative 4, 765 acres (3.2%) of substantial winter range within the Project Area would be disturbed. The disturbance to substantial winter range habitat would be less than that for Alternatives 2 and 3 (505 acres less than Alternative 2; 496 acres less than Alternative 3). The disturbance to crucial winter range under Alternative 4 (16 acres; 2.7% of crucial winter range within the Project Area) would be less compared to Alternatives 2 and 3. However, approximately the same acreage of crucial summer range would be disturbed under Alternative 4 (55 acres; 2.8% of crucial summer range within the Project Area) than crucial winter range disturbed under

Alternatives 2 and 3. Two ranges occur in the extreme northern (crucial winter range) and southern (crucial summer range) portions of the Project Area and represent a small portion of much larger ranges that extend to the north and south. In total, 836 acres of habitat would be impacted, which would account for 3.2% of the Project Area. This is 525 acres and 518 acres less than the total disturbance for Alternative 2 and 3, respectively. Disturbance would not exceed 0.8% of any crucial or substantial range within the Forest Service Analysis Area. The 836 acres of habitat impacted represents 0.5% of the crucial or substantial range in the Forest Service Analysis Area.

Under Alternative 4, 57 miles of new road would be constructed within the Project Area, for a total of 96 miles (which is 20 fewer miles than the Proposed Action). This increase in road density throughout the Project Area would reduce ―favorable" mule deer habitat in the Project Area to 938 acres (4% of available habitat), and 96% of the mule deer habitat would be considered ―unfavorable" (i.e., road density >0.16 km/km2). Alternative 4 would result in a well pad density of four well pads/square mile, which is considered a _moderate' impact to mule deer in crucial winter range (WGFD 2010). Well pad densities would be lower across the entire Project Area compared to Alternatives 2 and 3.

Although direct and indirect effects are likely to occur within the Project Area, these impacts would be less than those under Alternatives 2 and 3. Although, the road density analysis (Table 3-40) for Alternative 4 indicates that the Project Area may still be unfavorable to mule deer (96% unfavorable), the reduced well pad density would reduce the likelihood of this occurring and reduce the likelihood of the Forest Service Analysis Area receiving a decrease in deer numbers from impacts of the project.

Furthermore, based on the discussion under Alternative 2, even if the worst case scenario occurs (Project Area is avoided by deer, resulting in a decrease in deer numbers), it is determined that the Project under Alternative 4 may render the Project Area unfavorable to deer, may decrease deer numbers on the Forest Service Analysis Area, and possibly decrease deer numbers on the Anthro Herd Unit, but is unlikely to substantially decrease mule deer numbers on the Anthro Herd Unit. It is further determined, based on the discussion under Alternative 2, that under the worst case scenario (Alternative 4 possibly resulting in a decrease in deer numbers at the local population level), it is unlikely to have much effect to the trend in the deer population at the Forest-wide scale or much effect on the ability of the Forest to provide habitat for mule deer Forest-wide.

Rocky Mountain Elk

Direct and indirect impacts to elk would be the same as those identified for mule deer. The direct loss of habitat through the creation of roads and well pads, combined with indirect impacts such as the construction and operation of project roads and facilities; increased noise and human presence around well pads, roads, pipelines, and evaporative facilities; and decreased forage quality from fugitive dust are likely to affect elk.

Elk are known to respond negatively to areas where noise and human presence are elevated (greater than 0.5 mile) (Brekke 1988; Hayden-Wing Associates 1980; Hiatt and Baker 1981). Van Dyke and Klein (1996) reported that the installation of an oil well created shifts in elk range, centers of activity, and habitat use but elk did not abandon their range and social stability was not affected. The WGFD (2010) states that impacts from well pad densities over four well pads/square mile on elk crucial winter ranges and parturition areas are considered _Extreme' and habitat function would be substantially impaired and generally could not be recovered through management or habitat treatments. Impacts from well pad densities of four well pads/square mile or less on elk crucial winter

ranges and parturition areas are considered ‗Moderate'. To reduce these impacts, a seasonal timing stipulation would be implemented that would not allow drilling and new construction in elk crucial winter habitat between November 15 and April 30. This stipulation would ensure that there are fewer disturbances from construction and drilling during critical winter months, and fewer disturbances from traffic.

It is likely that project development would interfere with seasonal elk movements and migration routes through the Project Area. The degree of impact to elk migration routes may depend to a large extent on the arrangement of the well pad sites and associated roads. WGFD recommends keeping well pad density to four well pads per square mile in migration corridors wider than 0.5 mile and no surface occupancy in corridors less than 0.5 mile wide (WGFD 2010). Table 3-41 provides the acres of surface disturbance to elk habitat by alternative.

Table 41. Acres of Surface Disturbance (and Percentage of Total Designated Habitat) to Elk Habitat by Alternative.

	Acres within Project Area (FSAA)	Existing Disturbance	Alternative 1 (No Action)	Alternative 2 (Proposed Action) [1]	Alternative 3[1]	Alternative 4[1]
Crucial summer range	5,424 (57,457)	24 (0.4%, 0.04%)	0	159 (2.9%, 0.3%)	158 (2.9%, 0.3%)	165 (3.0%, 0.3%)
Crucial winter range	20,420 (81,574)	134 (0.7%, 0.2%)	0	1,199 (5.9%, 1.5%)	1,194 (5.8%, 1.5%)	652 (3.2%, 0.8%)
Crucial year-long	57 (18,787)	0	0	3 (5.3%, 0.02%)	3 (5.3%, 0.02%)	3 (5.3%, 0.02%)
Total	**25,901 (186,923)**	**158 (0.6%, 0.1%)**	**0**	**1,361 (5.3%, 0.7%)**	**1,355 (5.2%, 0.7%)**	**820 (3.2%, 0.4%)**

[1] Total acres of surface disturbance and (in parentheses) percent of habitat disturbed. First value represents the percentage of the disturbance acres to the total designated habitat within the Project Area; second value represents the percentage of the disturbance acres to the total designated habitat within the Forest Service Analysis Area.

Lyon (1983) found that elk preferentially use habitat where road densities are ≤0.62 km/km2. For the purposes of this analysis, all habitats where road density would exceed 0.62 km/km2 are considered unfavorable. Table 3-42 shows the results of the analysis and remaining favorable habitat.

Nearly all habitats within the project area are currently being used by elk. However, taking into account only existing roads, 13,460 acres (53%) of elk habitat in the Project Area is currently ―unfavorable" due to habitat fragmentation, as defined by portions of the Project Area where road densities are >0.62 km/km2. The discrepancy between habitat

that the above analysis shows is favorable to elk and what habitat elk currently use (all habitats in Project Area) is likely explained by the low level of traffic and noise disturbance that currently occurs on these roads, which exhibit a lower degree of avoidance by elk than what the analysis depicts for existing conditions. As the additional roads created for the project would likely receive a higher degree of traffic and noise disturbance (from construction, drilling, and continual traffic of trucks during the production phase) than currently occurs on existing roads, the analysis will serve to explain the potential changes of elk habitat to unfavorable amongst alternatives.

Table 3-42. Road Density in Elk Habitat by Alternative.

	Within Project Area	Alternative 1 (No Action Alternative)	Alternative 2 (Proposed Action)	Alternative 3	Alternative 4
Total miles of road[1]	39	39	116	114	96
Acres of favorable elk habitat (road density ≤0.62 km/km^2)	12,148	12,148	1,601	1,848	2,573
Percent of available habitat in Project Area that is favorable[2]	47	47	6	7	10

[1] Includes existing maintained roads, upgraded roads, and new roads. Does not include existing two-track roads that would not be upgraded.

[2] Available habitat in Project Area = 25,901 acres

Under all action alternatives, existing guzzlers present near proposed well pads would be moved by Operators to reduce the impacts of increased traffic and human presence on elk. Also, well pad and road construction, road upgrades, work over rigs, and drilling operations would not be conducted between November 15 and April 30 to protect elk winter range, as required by seasonal stipulations. Additionally, springs and Sowers Creek would be protected by a no disturbance buffer (riparian mitigation under bats and sparrows). This would protect water sources for elk.

Alternative 2

Under Alternative 2, 1,199 acres (5.9%) of crucial winter range within the Project Area would be directly disturbed. There would be 159 acres of disturbance (2.9% of the Project Area) to crucial summer range and 3 acres (5.3%) of disturbance to crucial year-long range. Crucial year-long range occurs in the extreme southeastern portion of the Project Area and represents a small portion of this range which extends to the east. In total, 1,361 acres of habitat would be impacted, which would account for 5.3% of the Project Area. Disturbance to crucial winter range would be 1.5% of the elk crucial range within the Forest Service Analysis Area, but disturbance to crucial summer or year-long range would not exceed 0.3% of those ranges within the Forest Service Analysis Area. The 1,361 acres of elk ranges impacted represents 0.7% of all elk ranges the Forest Service Analysis Area.

Under the Proposed Action, 77 miles of new roads would be constructed within the Project Area, for a total of 116 miles of roads. This increase in road density throughout the

Project Area would reduce favorable elk habitat in the Project Area to 1,601 acres (6% of available habitat). Therefore, 94% of the elk habitat would be considered ―unfavorable" (i.e., road density >0.62 km/km2). This would be a 47% increase of unfavorable habitat in the project area from existing conditions. Road densities are lower within the non-project portion of the Forest Service Analysis Area and elk may move into those more favorable areas.

Alternative 2 would range in well pad density from four well pads/square mile in the southern portion of the Project Area to 16 well pads/square mile in the northern portion. The WGFD (2010) considers this well pad density ‗Extreme' and habitat function could be substantially impaired and generally could not be recovered through management or habitat treatments.

Disturbance associated with project activities combined with the direct loss of elk crucial habitat, increased road densities, a 47% increase of unfavorable habitat in the Project Area, 6% of the Project area in favorable elk habitat, and higher well pad densities (up to 16 well pads per square mile) would have direct and indirect impacts to elk within the Project Area. In the absence of adequate mitigation to provide measures to reduce these direct and indirect impacts, a large portion of the Project Area may become unfavorable to elk and this may cause elk to avoid the area. This would likely decrease the number of elk that the Forest Service Analysis Area could support.

Although the project under Alternative 2 may decrease elk numbers on the Forest Service Analysis Area, it is unlikely to substantially decrease (20% decrease) elk numbers within the Anthro Herd Unit. The worst case scenario would be that the Project Area, all of which is considered crucial elk habitat (winter, summer, and year-long), would no longer be available to elk. However, there is far more ―crucial" elk habitat within the Herd Unit than within the Project Area or within the Forest Service Analysis Area. The Project Area (approximately 25,901 acres) is only 14% of the Forest Service Analysis Area (186,923 acres described in the Environmental Consequences Section) and only 4% of the Anthro Herd Unit (639,228 acres – boundary described at the beginning of the Cumulative Impacts Section). Based on these percentages, it is unlikely that changing only 4% of the Anthro Elk Herd Unit to an unfavorable condition for elk would equate to a 20% decrease in elk numbers within the Herd Unit. Furthermore, even though 53% of elk habitat in the Area is currently considered ―unfavorable" the Anthro Elk Unit has experienced a dramatic increasing trend in the elk population the last 6 years and is now double the population objective of 700 elk. This current trend further reduces the likelihood of the project substantially decreasing the elk population in the Herd Unit. Reductions in the elk population in the future is likely to come from hunting, since the DWR is aggressively increasing the issuance of cow elk tags to bring the elk population back down to the population objective of 700 elk. Also, calving habitat is not a limiting factor to elk populations on the Forest and a reduction in calving habitat would not have as much affect to elk as would the reduction in ―crucial" winter habitat.

Looking at the discussed impacts to elk from the project at the larger Forest-wide scale it is unlikely that the project under this alternative would have much decrease to elk populations Forest-wide. The Forest overlaps 5 other Elk Herd Units, and contains 1,384,132 acres, of which nearly all is considered elk habitat (Forest Service 2006a). If the impacts from the project render the approximately 25,901 acre Project Area unfavorable to elk, that would equate to less than a 2% loss of elk habitat Forest-wide.

Based on the analysis and discussion above, it is determined that Alternative 2 may render the Project Area unfavorable to elk, may decrease elk numbers on the Forest Service

Analysis Area, and possibly decrease elk numbers on the Anthro Herd Unit, but is unlikely to substantially decrease elk numbers on the Anthro Herd Unit. It is further determined that although Alternative 2 may possibly result in a decrease in elk numbers at the local population level, it is unlikely to have much effect to the trend in the elk population at the Forest-wide scale or much effect on the ability of the Forest to provide habitat for elk Forest-wide.

Alternative 3

Under Alternative 3 there would be the same impacts to elk as was described under Alternative 2, with the following exceptions. Under Alternative 3, there would be 1,194 acres (5.8%) of crucial winter range within the Project Area disturbed. This amount is 5 acres less than the disturbance to crucial winter range for the Proposed Action. Alternative 3 would also result in 158 acres (2.9%) of disturbance to crucial summer range and 3 acres (5.3%) of disturbance to crucial year-long range. In total, 1,355 acres of habitat would be impacted, which would account for 5.2% of the Project Area. This is 6 acres less than the total disturbance for the Proposed Action.

Alternative 3 would phase the project in over time. By phasing the project over time, portions of the Project Area would have focused areas of disturbance, thus concentrating human activity and disturbance to certain drainages and ridgelines within the Project Area. In addition, mitigation associated with this alternative includes developing a specific POD to limit and/or mitigate sagebrush habitat fragmentation. However, although these measures each contribute to reduce indirect impacts to elk, crucial habitat loss, road densities, and well pad densities are equivalent to those under Alternative 2. Therefore, Alternative 3 would likely result in the same impacts as is described in Alternative 2.

Based on this discussion and on the discussion under Alternative 2, it is determined that the project under Alternative 3 may render the Project Area unfavorable to elk, may decrease elk numbers on the Forest Service Analysis Area, and possibly decrease elk numbers on the Anthro Herd Unit, but is unlikely to decrease elk numbers on the Anthro Herd Unit by 20%. It is further determined, based on the discussion under Alternative 2, that although the project under Alternative 3 may possibly result in a decrease in elk numbers at the local population level, it is unlikely to have much effect to the trend in the elk population at the Forest-wide scale or much effect on the ability of the Forest to provide habitat for elk Forest-wide.

Alternative 4

Under Alternative 4, impacts to elk would be the same as Alternatives 2 and 3, but to a lesser degree. Under Alternative 4, 652 acres (3.2%) of crucial winter range within the Project Area would be disturbed. The disturbance to crucial winter range is less than that for Alternatives 2 and 3 (547 acres less than Alternative 2; 542 acres less than Alternative 3). However, slightly more crucial summer range would be disturbed compared to Alternatives 2 and 3. Alternative 4 would disturb 165 acres (3.0%) of crucial summer range within the Project Area, which is 6 acres more than Alternative 2 and 7 acres more than Alternative 3. Only 3 acres (5.3%) of crucial year-long range would be disturbed within the Project Area, which is the same amount of disturbance as Alternatives 2 and 3.

In total, 820 acres of crucial elk ranges would be impacted, which would account for 3.2% of habitat in the Project Area. This is 2% less than the total disturbance for Alternatives 2 and 3. Disturbance to crucial winter range would be 0.8% of the elk crucial range available within the Forest Service Analysis Area, but disturbance to crucial summer or year-long range would not exceed 0.3% of those ranges within the Forest Service Analysis

Area. The 820 acres of elk habitat impacted represents 0.4% of elk habitat in the Forest Service Analysis Area.

There would be 57 miles of new road would be constructed within the Project Area, for a total of 96 miles of roads. This increase in road density throughout the Project Area would reduce favorable elk habitat in the Project Area to 2,573 acres (10% of available habitat). Therefore, 90% of the elk habitat would be considered unfavorable (i.e., road density >0.16 km/km2). Road densities are lower within the non-project portion of the Forest Service Analysis Area and elk may move into those more favorable areas.

Alternative 4 would result in an average well pad density of four well pads/square mile, which, within elk crucial winter range, is considered ‗High' (WGFD 2010). Well densities would be lower across the entire Project Area compared to Alternatives 2 and 3; however, activities would not be concentrated to particular portions of the Project Area as proposed in Alternative 3. Alternative 4 is more likely to maintain elk migratory movements in the northern portion of the Project Area, as compared to Alternatives 2 and 3 which propose 16 well pads/square mile in this migratory area.

Disturbance to elk crucial winter range would not exceed 0.8% of that range within the Forest Service Analysis Area and there would be a continued availability of larger areas of undisturbed habitat outside the Project Area. Although, the road density analysis for Alternative 4 indicates that the Project Area may still be unfavorable to elk (96% unfavorable), the reduced well pad density would reduce the likelihood of this occurring and reduce the likelihood of the Forest Service Analysis Area receiving a decrease in elk numbers from impacts of the project.

Based on the discussion under Alternative 2, even if the worst case scenario occurs (Project Area is avoided by elk, resulting in a decrease in elk numbers), it is determined that the project under Alternative 4 may render the Project Area unfavorable to elk, may decrease elk numbers on the Forest Service Analysis Area, and possibly decrease elk numbers on the Anthro Herd Unit, but is unlikely to decrease elk numbers on the Anthro Herd Unit by 20%. It is further determined that based on the discussion above, Alternative 4 under the worst case scenario is unlikely to have much effect to the trend in the elk population at the Forest-wide scale or much effect on the ability of the Forest to provide habitat for elk Forest-wide.

Northern Goshawk

Analysis and findings for Northern Goshawk can be found in section 3.9.2.2.

Sage Grouse

Analysis and findings for Sage grouse can be found in section 3.9.2.2.

Golden Eagle

Cliffs will not be affected by the project, therefore this type of golden eagle nesting habitat would not be affected. Also, no nests have been documented within or near the Project Area. Therefore, disturbance to golden eagle nests from the project are unlikely.

In the event that a golden eagle nest is found in the Project Area during subsequent surveys, no permanent surface occupancy would be allowed within a 0.5 mile buffer of the nest to protect nesting golden eagles. To further protect nesting golden eagles, any temporary project activities within this 0.5 mile buffer would not be allowed between April 30th and August 31. Also, camouflage netting would be required during project

construction activities to shield equipment and structures where there is line of sight from active nests to the activity.

Since golden eagles use habitats in the Project Area for foraging, any surface facility, ongoing traffic, or human presence that may occur within the Project Area could increase habitat fragmentation and reduce prey levels or remove prey species habitat, thus reducing prey availability. However, since most golden eagle prey species (ground squirrels, rabbits, mice, birds, reptiles) generally have small home ranges or territories (several hectares or smaller), and given the minimal amount of surface disturbances (less than 2.5% of the Project Area and less than 1% of the Forest Service Analysis Area), it is unlikely that prey species would be substantially affected by the loss of habitat form the footprint of the roads and well pads. It is therefore likely that prey would likely still be available for golden eagles within the Project Area.

Noise disturbances from project activities extend beyond the footprint of the roads and well pads. This may potentially cause golden eagle avoidance of these areas during the construction phase and use of access roads. Studies have mixed results, with some studies showing golden eagles disturbed by human disturbance and other studies showing golden eagles are not disturbed by humans (Kochert 2002). Under the proposed action the density of roads and well pads may increase the likelihood of golden eagle avoidance of the area. Although avoidance is possible during construction and drilling, those impacts are short term and likely would only occur in a few areas of the project at any given time. Thus, leaving other areas of the habitat within the Project Area at any given time unaffected by construction and drilling.

Poisoning or drowning could occur at evaporative facilities (reserve pits); however, netting or other deterrents would be used to prevent impacts to birds in these areas.

Under Alternative 2, approximately 649 acres of potential foraging habitat would be permanently disturbed (2.5% of the Project Area; 0.7% of the Forest Service Analysis Area).

The same impacts to golden eagles would occur under Alternative 3 as is described for Alternative 2 with the following exceptions. By phasing the project over time, portions of the Project Area would have focused areas of disturbance (e.g., vehicular activity), thus concentrating human activity and disturbance to certain drainages and ridgelines within the Project Area. This would provide larger, disturbance-free foraging areas over the duration of construction and drilling operations.

Impacts to golden eagles under Alternative 4 would be the same as is described for Alternatives 2 & 3, but to a lesser degree. This Alternative would result in the permanent disturbance of 537 acres of potential foraging habitat (2.1% of the Project Area; 0.6% of the Forest Service Analysis Area). This is 112 and 109 acres less than the amount of permanent disturbance under Alternatives 2 and 3, respectively. Average patch size under Alternative 4 would be reduced from 2,151 acres (under existing conditions) to 1,416 acres, which includes a minimum size of less than 1 acre and a maximum patch size of 5,519 acres; the number of patches would increase from 12 to 17. The degree of fragmentation would be less than Alternatives 2 and 3, due to fewer miles of road, fewer well pads, fewer habitat patches, larger habitat patches, and greater distances to disturbance.

Mitigation measures would prevent surface occupancy in close proximity to nest locations (if discovered), seasonal timing restrictions in close proximity to nest locations (if discovered) would be implemented, reduced visual impacts (disguising equipment) in

areas close to nest locations (if discovered), and prevention of mortality by netting evaporative facilities. Based on this rational, it is determined that the action alternatives may impact individual golden eagles, but would not affect the trend of populations of this species in the ANF or impair the ability of the forest to provide habitat for the species.

Lincoln's Sparrow

Direct impacts to the Lincoln's sparrow would be limited to the riparian shrublands along Sowers Creek (122 acres in the Project Area). There is a low potential for this species to nest in this area due to the elevation, but they are likely to use the habitat during migration. Site-specific impacts would be dependent upon the location of each well. Additional indirect impacts may occur as the result of noise from well pad and road construction in habitats adjacent to riparian areas, including pinyon-juniper woodland and sagebrush shrublands. If construction and drilling of well pads and roads occurred during the peak migration months, the Proposed Action and alternatives could result in some displacement of foraging birds due to increased noise, vehicular activity, and human presence. However, the low elevation of the Project Area suggests that nesting would be unlikely in the area and disturbance to nesting Lincoln's sparrows would likewise be unlikely. To evaluate potential impacts the loss of riparian habitat was assessed within the Project Area. Table 3-43 provides the amount of short- and long-term disturbance to Lincoln's sparrow nesting and foraging (riparian) habitat within the Project Area.

Table 3-43. Surface Disturbance of Lincoln's Sparrow and Song Sparrow Habitat within the Project Area.

	Alternative 1 (No Action Alternative)	Alternative 2 (Proposed Action)	Alternative 3	Alternative 4
Acres of short-term disturbance[1]	0	15	18	9
Acres of long-term disturbance[2]	0	9	10	7
Percent of habitat disturbed, long-term[3]	0	7.4, 1.5	8.2, 1.7	5.7, 1.2

[1] Short-term disturbance includes those acres disturbed during drilling and completion phases.

[2] Long-term disturbance includes those acres disturbed after interim reclamation.

[3] Percent of riparian habitat disturbed. First value represents the percentage of disturbance acres to the riparian habitat within the Project Area (122 acres); second value represents the percentage of disturbance acres to the riparian habitat within the portion of the CIAA/Forest Service Analysis Area (584 acres).

Under all action alternatives some access roads would cross Sowers Creek to reach well pads, which could fragment sparrow habitat. Road construction and well pad drilling could result in some displacement of foraging birds due to increased noise, vehicular activity, and human presence. However, with the exception of stream crossings, a 150 foot buffer would be placed along Sowers Creek. This would reduce disturbance to this species habitat. If displacement of individuals does occur, it would do so on a temporary and limited level due to the small amount of disturbance to riparian habitat and limited timing of drilling activities within riparian habitat within the Project Area. Due to the low elevation of the project and the low likelihood of Lincoln's sparrows occurring in the Project Area, the relatively low likelihood of displacement and vehicle impacts, the no

disturbance buffer of Sowers Creek (except for stream crossings), and the minimal amount of riparian habitat potentially disturbed in the long term by stream crossings (9 acres and 7.4% of habitat in the project area for Alternative 2, 10 acres and 8.2% of riparian habitat for Alternative 3, and 7 acres 5.7% of the riparian habitat for Alternative 4), and the netting of reserve pits, it is determined that the Proposed Action may impact individual Lincoln‘s sparrows, but would not affect the trend of populations of this species in the ANF or impair the ability of the forest to provide well-distributed habitat for the species.

Song Sparrow

Direct and indirect impacts to the song sparrow would be the similar to those described for Lincoln‘s sparrow (e.g., vehicle collisions, displacement from foraging habitat, entrapment in reserve pits). However, unlike Lincoln sparrow, the song sparrow is likely to nest within the riparian habitat of Sowers Canyon. Therefore, noise from construction, vehicular traffic, and drilling of well pads could disturb some song nesting sparrows. However, song sparrows do not appear to be affected by noise associated with roads and human presence (Arcese et. al. 2002). Therefore, noise disturbance from project activities are unlikely to displace nesting or foraging song sparrows. Additionally, with the exception of stream crossings, a 150 foot buffer would be placed along Sowers Creek, and another mitigation for bats buffers springs by 100 feet. These mitigations would reduce noise and surface disturbance to this species habitat and further reduce the likelihood of displacement or disturbance to nesting sparrows. If displacement of individuals does occur, it would do so on a limited level due to the small amount of riparian habitat within the Project Area (see Table 3-43). Direct impacts to song sparrows were assessed as the loss of riparian habitat within the Project Area. Table 3-43 provides the amount of short- and long-term disturbance to riparian habitat within the Project Area. Differences of potential impacts to song sparrows between alternatives are analyzed below under each alternative.

Since nesting song sparrows are not likely to be disturbed by noise (Arcese et. al. 2000), buffers required around riparian areas (along Sowers Creek and around springs), riparian shrubland habitat loss being minimal, the short-term nature of construction and drilling activities in any given area at any given time, it is determined that the action alternatives may impact individual song sparrows, but would not affect the trend of populations of this species in the ANF or impair the ability of the forest to provide well-distributed habitat for these species.

Warbling Vireo

Aspen forests would not be directly impacted under any of the alternatives. The access roads up at the top of Nutters Ridge and Wire Fence Ridge pass through and near aspen stands, so vireos in these areas have the potential to be affected by noise and disturbance from truck traffic. Indirect impacts to warbling vireo could also occur as the result of well pad and road construction in habitats adjacent to aspen stands, including sagebrush shrublands. However there is only 3 acres of aspen within the project area (only 0.5% of aspen within the Forest Service Analysis Area) and the distribution of roads and well pads within the portion of the Project Area where there is aspen habitat would be minimal and is not likely to cause any indirect effects to this species.

Direct impacts include mortality by vehicle collisions, although this is unlikely as there is so little warbling vireo habitat (3 acres) within the project area and so little habitat is potentially affected. There is also a potential for entrapment in, or contamination from, toxic fluids and oil present in reserve pit fluids (USFWS 2009). However, this threat

would be minimized by using netting to cover all open contaminated-water impoundments associated with drilling operations. Also, if closed-loop drilling is used as a BMP, the risk of contamination or entrapment of migratory birds would be reduced by eliminating reserve pits.

Impacts would be the same for Alternatives 2 and 3. Due to the little amount of habitat on the Project Area (3 acres and only 0.5% of habitat within the Forest Service Analysis unit), low disturbance to aspen habitat, the likelihood of the project only affecting a few individuals, combined with mitigation measures aimed at preventing reserve pit mortality, it is determined that Alternatives 2 and 3 may impact individual warbling vireos, but would not affect the trend of populations of this species in the ANF or impair the ability of the forest to provide well-distributed habitat for the species.

The impacts to warbling vireos would be the same for Alternative 4 as is described for Alternatives 2 and 3, with one exception. Sage grouse mitigations for Alternative 4 prevents the use of the access roads on Nutters and Wire Fence ridges (south of the Operators lease) that pass through the small aspen stands discussed above. This would eliminate disturbance to any warbling vireo using those aspen stands. Therefore, impacts would be less under Alternative 4 than the other two action alternatives. Based on this and the above discussion, it is also determined that Alternative 4 may impact individual warbling vireos, but would not affect the trend of populations of this species in the ANF or impair the ability of the forest to provide well-distributed habitat for the species.

Red-naped Sapsucker

Red-naped sapsuckers also occur in aspen forests, and potential impacts would be the same as those described for warbling vireo. Indirect impacts could occur as the result of access roads that pass through aspen stands (Nutters and Wire Fence ridges access roads south of the Operators lease), well pad and road construction in habitats adjacent to aspen stands. However, nesting and foraging red-naped sapsuckers do not appear to be disturbed by human activity and vehicular traffic along roads (Walters et. al. 2002). Therefore, these birds are not likely to be disturbed by noise disturbances associated with roads/trails under these alternatives. Additionally, the Ashley NF Forest has documented several red-naped sapsucker nests near human activity such as in close proximity to campgrounds, high use administration sites, and next to popular hiking and horse packing trails. This seems to support the findings of Walters et.al. Therefore, it is unlikely that nesting red-naped sapsuckers would be disturbed by the project activities. Furthermore, there are only 3 acres of aspen within the project area (only 0.5% of aspen within the Forest Service Analysis Area) and the distribution of roads and well pads within the portion of the Project Area where there is aspen habitat would be minimal and is not likely to cause any indirect effects to this species.

Direct impacts include potential entrapment in, or contamination from, toxic fluids and oil present in reserve pit fluids (USFWS 2009). This threat would be minimized by using netting to cover all open contaminated-water impoundments associated with drilling operations. Also, if closed-loop drilling is used as a BMP, the risk of contamination or entrapment of migratory birds would be reduced by eliminating reserve pits.

Impacts would be the same for Alternatives 2 and 3. Due to the little amount of habitat on the Project Area (3 acres and only 0.5% of habitat within the Forest Service Analysis unit), low disturbance to aspen habitat, the likelihood of red-naped sapsuckers being tolerant of project activities, combined with mitigation measures aimed at preventing reserve pit mortality, it is determined that Alternatives 2 and 3 may impact individual red-

naped sapsuckers, but would not affect the trend of populations of this species in the ANF or impair the ability of the forest to provide well-distributed habitat for the species.

The impacts to red-naped sapsuckers would be the same for Alternative 4 as is described for Alternatives 2 and 3, with one exception. Sage grouse mitigations for Alternative 4 prevents the use of the access roads on Nutters and Wire Fence ridges (south of the Operators lease) that pass through the small aspen stands discussed above. This would eliminate disturbance to any red-naped sapsuckers using those aspen stands. Therefore, impacts would be less under Alternative 4 than the other two action alternatives. Based on this and the above discussion, it is also determined that Alternative 4 may impact individual red-naped sapsuckers, but would not affect the trend of populations of this species in the ANF or impair the ability of the forest to provide well-distributed habitat for the species.

3.9.2.6 Cumulative Impacts

The CIAA for Forest Service MIS (red-naped sapsucker, warbling vireo, Lincoln‘s sparrow, song sparrow, and golden eagle) is the Forest Service Analysis Area (FSAA), a total area of 186,923 acres. Refer to the sensitive species section for a cumulative impacts discussion on sage grouse and goshawk. This CIAA/FSAA is bounded by Highway 191 to the west, the First Standard Parallel to the north, Wells Draw road to the east, and Five Mile Canyon Road and the southern Forest boundary of the South Unit on the south. This area was selected as the CIAA, because it is large enough to capture effects that may cumulatively affect wildlife on Forest Service lands (portion of the South Unit east of Hwy 191) as well as those impacts to wildlife on adjacent lands BLM and Tribal lands surrounding the Forest and the Project Area.

The CIAA for elk is the Anthro Elk Herd Unit, which encompasses 639,228 acres and is bounded by U.S. 191 to the west; Argyle Canyon Road, Nine Mile Canyon Road, and Nine Mile Creek to the south; the Green and Duchesne rivers to the east; and U.S. 40 to the north. This area was selected as the CIAA, because it is large enough to capture effects that may cumulatively affect elk on Forest Service lands (portion of the South Unit east of Hwy 191) as well as those impacts to elk on adjacent lands surrounding this portion of the Forest and the Project Area. This area was also selected for elk CIAA to capture cumulative impacts within the Herd Unit.

The term ―wildlife” below refers to MIS, except sage grouse. Refer to the sensitive species section for a discussion of cumulative impacts to sage grouse and goshawk.

RFFAs in the CIAA that could impact these MIS include oil and gas exploration and mineral resource extraction, recreation, wildlife habitat improvement projects, and livestock grazing. Past, present, and RFFAs regarding energy development projects (e.g., Vantage wells and the oil and gas development on adjacent BLM and tribal lands) would be similar to those impacts discussed above for the project. These cumulative activities may increase impacts to wildlife. There is very little, if any habitat for the red-naped sapsucker and warbling vireo on non-Forest Service lands within the CIAA. Therefore, impacts to these species from activities off Forest Service lands are unlikely to occur. Riparian would be protected by mitigations under all Action Alternatives. As riparian is commonly valued, it is reasonable to assume that riparian areas elsewhere in the CIAA would also be protected from oil and gas development, thus minimizing cumulative impacts to Lincoln‘s sparrows and song sparrows. Also, for activities on Forest Service lands, surface use and seasonal restrictions would be required to protect wildlife. It is possible for golden eagle prey species to affected by energy developments on adjacent

lands within the CIAA. However, since most golden eagle prey species (ground squirrels, rabbits, mice, birds, reptiles) generally have small home ranges or territories (several hectares or smaller), the chance of these prey species habitat being substantially fragmented by the project cumulative impacts within the CIA when combined with the project is relatively low compared to larger species that rely on large home ranges and territories.

As oil and gas development in the Herd Unit has been expanding, the elk population within the Herd Unit has increased to the point of doubling the population objective of 700 elk (720 in 2005 to 1,400 in 2011). Likewise the deer population has increased slightly (Christensen 2011b). Additionally, as the Project Area represents only 4% of the Herd Unit, it is unlikely that changing 4% of habitat to unfavorable would have much effect to elk and deer numbers within the Herd Unit and is unlikely to decrease elk and deer numbers in the Herd Unit by 20%, even when combined with oil and gas activities off Forest lands.

Recreation impacts include hunting, camping, and firewood gathering. Past, present, and RFFAs for wildlife habitat improvement projects include prescribed burns and conifer encroachment projects. As the project is unlikely to increase recreation activities, it is likewise unlikely to increase impacts to wildlife when combining the project with recreation activities. Prescribed burns within the CIAA include two projects totaling 3,200 acres; approximately 1,150 of the 1,200 acres of the Anthro Mountain target area have already been completed and no areas have been treated within the Antelope Canyon prescribed burn area. These burn areas are targeting dense sagebrush habitats (including isolated stands of aspen) with a canopy cover greater than 20%. Conifer encroachment projects that have occurred and are proposed to occur within the CIAA consist of mechanical treatments to deter the encroachment of pinyon, juniper, and Douglas-fir trees into shrub communities. These projects may cause some temporary disturbance to wildlife, but the long term results would benefit most wildlife species. Therefore combining these habitat projects with the proposed project is unlikely to have negative effects to wildlife. The CIAA also contains almost 95,000 acres of cattle grazing allotments. Cattle grazing activities associated with these allotments may reduce available forage habitat and prey species. Grazing allotments on the Forest take wildlife needs into consideration and ensure there is a residual amount of forage for wildlife. Therefore, there would be minimal impacts to wildlife, when grazing is combined with the project.

Based on the above rational it is determined that combining cumulative impacts with project may impact individual MIS (red-naped sapsucker, warbling vireo, Lincoln‘s sparrow, song sparrow, and golden eagle), but would not affect the trend of populations of these species in the ANF or impair the ability of the forest to provide habitat for these species.

Additionally, based on the above cumulative impacts discussion and direct and indirect, sections, it is determined that the above cumulative impacts combined with the worst case scenario of the project (Project Area is avoided by elk and deer, resulting in a decrease in elk and deer numbers) may render the Project Area unfavorable to elk and deer, may decrease deer and elk numbers on the Forest Service Analysis Area (FSAA), and possibly contribute to a decrease in elk and deer numbers on the Anthro Herd Unit (CIAA) in the future, but is unlikely to decrease elk and deer numbers on the Anthro Herd Unit by 20% in the near future. It is further determined, based on the discussion above and the much larger size of the Ashley NF overlapping five other elk Herd Units and 4 other deer Units, that under the worst case scenario, it is unlikely to have much effect to the trend in the elk

and deer population at the Forest-wide scale or much effect on the ability of the Ashley NF to provide habitat for elk and deer Forest-wide.

3.9.2.7 Macroinvertebrates

The only drainage within the Project Area that would contain macroinvertebrates is the perennial drainage of Sowers Creek. Direct impacts of the Proposed Action and action alternatives on the macroinvertebrate community in Sowers Creek would consist of several creek crossings by access roads to well sites. Indirect impacts would include a decrease in water quality due to erosion and sediment yield caused by surface disturbance. The Proposed Action and alternatives would include several road crossings and well sites in close proximity to Sowers Creek and its tributaries (primarily Mine Hollow). Additional road crossings and well sites at tributaries to Sowers Creek have the potential to impact portions of Sowers Creek outside of the Project Area. Therefore, impacts will be assessed as the amount of short- and long-term disturbance within the Project Area.

Short-term surface disturbance would create localized peaks in erosion of sediment depending on the season and distribution of surface-disturbing activities throughout the Project Area. Long-term impacts would occur over a broader portion of the Project Area, as well site construction is completed and vehicular activity along access roads continues for the purposes of operational activities. Due to the low level of short-term (3.2% to 5.3% of the Project Area) and long-term (1.6% to 2.3% of the Project Area) surface disturbance, adverse effects on macroinvertebrates in the Project Area would be negligible, and it is determined that the proposed project would not affect the trend or viability of macroinvertebrates in the ANF or impair the ability of the ANF to provide well-distributed habitat for these species.

3.9.2.8 Mitigation

Effects Common to all Action Alternatives

Elk and Deer

Well pad and road construction, road upgrades, and drilling operations would not be conducted between November 15 and April 30 to protect elk winter range.

Existing guzzlers present near proposed well pads would be reconstructed by the Operator in new locations away from well pads, in order to reduce the impacts of increased traffic and human presence on elk, mule deer, and other wildlife utilizing those structures for drinking.

Riparian buffers listed under the bats and sparrows sections would protect natural water sources (springs and Sowers Creek) currently available to big game from disturbance. Mitigations under bats and bird species would also require netting to be placed over reserve pits, which would prevent big game from drinking contaminated water.

Alternative 3 includes the following additional measures to protect migrating ungulates; minimize noise, traffic, and other construction-related activities in large portions of the Project Area; and limit sagebrush habitat fragmentation.

- Developing a separate POD for drilling in crucial mule deer winter range and summer range.
- Reducing surface density of facilities, roads, pipelines, and other ROWs.
- Focusing developments near existing ROWs.

- Clustering facilities, including the use of directional drilling where feasible.
- Minimizing oil- and gas-related activity in sagebrush habitats, including reducing traffic through field road management, closing routes to public use, remote telemetry of wells, and piping of produced fluids rather than trucking.
- Using new technologies, including surface mats, self-contained rigs, limited impact drilling (e.g., small roads and small pads).
- Requiring mandatory acceptance of BMPs, including painting production facilities to minimize contrast with background, drilling multiple wells on an individual well pad, centralized production facilities, closed-loop drilling, minimizing topsoil removal during drilling activities, and installation of raptor perch avoidance devices.
- Developing mitigation proposals.
- Developing a wildlife monitoring plan.

Golden Eagle

Although no golden eagle nests have been documented within the Project Area, aerial and/or ground surveys of the proposed Project Area would be conducted prior to construction activities to identify active or potentially active golden eagle nest sites.

If golden eagle nests are detected within the Project Area, the following mitigation measures would be implemented to protect nesting golden eagles.

- No permanent surface occupancy would be allowed within 0.5 mile of an active golden eagle nest to reduce the risk of decreased productivity or nest failure, unless topography eliminates the risk of abandonment.
- Unless topography eliminates the risk of nest abandonment, no temporary project activities can occur within a 0.5 mile buffer of an occupied golden eagle nest between April 30 and August 31.
- Shielding pipeline installation equipment, well sites, and other facilities with camouflage netting, where there is line of sight from active nests to the activity.
- All open contaminated-water impoundments associated with drilling operations (reserve pits) will be covered with netting to prevent birds from accessing toxic and contaminated water.

Lincoln's and Song Sparrow

Mitigation measures for Lincoln‘s sparrow include:

- covering all open contaminated-water impoundments associated with drilling operations (reserve pits) with netting to prevent birds from accessing toxic and contaminated water; and
- A 150 foot buffer along each side of Sowers Creek for well pads and roads, with the exception of stream crossings.

Warbling Vireo and Red-naped Sapsucker

- All open contaminated-water impoundments associated with drilling operations (reserve pits) would be covered with netting to prevent birds from accessing toxic and contaminated water.

3.9.2.9 Migratory Birds

Potential impacts to migratory birds would be similar to those identified for the various bird species above, and include reduced foraging and nesting opportunities, reduced cover, increased risk of vehicle-related mortality, and displacement and nest abandonment due to increased noise and human activities in areas surrounding nesting habitat. For many bird species, the development of new roads would contribute to fragmentation of habitat, and the loss of habitat due to well pad and road construction in addition to indirect effects radiating beyond the road/well pad footprint (edge effects) could result in an additional loss of nesting and foraging habitat or reduced suitability of that habitat. If construction and drilling activities caused birds to abandon their nest, individuals may either re-nest in an area removed from such disturbances during the same season (if abandonment occurred early enough into the nesting season) or abandon the nest and re-nest the following year; if the nest was abandoned or lost, the reduction of several nests would not be enough to cause a decline in migratory bird species as a whole. Also, some bird species are tolerant of human activities and may not be displaced as easily as others. However, to reduce the disturbance to nesting birds, surveys would be conducted prior to ground disturbing activities that would occur during the migratory bird nesting season (May 15-June 30th). If nests are detected, then a 0.1 mile no disturbance buffer would be placed around the nest. Any nests recorded during nest surveys would be buffered to reduce impacts to nesting birds. Reserve pits that contain oil or oil-based products (i.e., oil-based drilling fluids) can entrap and kill migratory birds and other wildlife (USFWS 2009). However, mitigation to cover reserve pits would reduce this risk. Also, if closed-loop drilling is used as a BMP, the risk of contamination or entrapment of migratory birds would be reduced.

Impacts would vary based on the habitat type(s) that the birds are associated with, including pinyon-juniper woodland, sagebrush, brushlands, riparian, and deciduous or coniferous forest, including ponderosa pine, Douglas-fir, and aspen. Table 3-44 provides the amount of surface disturbance associated with each alternative per habitat type. Birds of Conservation Concern (BCC) Region 16 and Partners in Flight (PIF) Priority Species associated with these habitat types are listed in Table 3-45.

The majority of surface disturbance under the Proposed Action and action alternatives would be in pinyon-juniper woodlands, and therefore migratory bird species associated with this habitat type would be most affected. However, the greatest proportion of habitat type disturbed within the Project Area would occur in riparian habitats; short-term disturbance would range from 5.7% to 14.8% of riparian habitat within the Project Area. Short-term sagebrush habitat disturbance would be less than pinyon-juniper woodlands disturbance (in terms of acres disturbed) but when compared to the proportion of pinyon-juniper woodland habitat lost, a higher proportion of sagebrush habitat would be disturbed relative to the amount of sagebrush habitat within the Project Area. Short-term disturbance to sagebrush habitats would range from 6.0% to 9.0% of the sagebrush habitat within the Project Area. There would be no surface disturbance in aspen forest, but access roads up at the top of Nutters Ridge and Wire Fence Ridge (south of the Operators lease) would pass through and near these aspen stands, so some indirect impacts to migratory birds associated with aspen could occur there.

Long-term disturbance of habitat types would not exceed 4.1% of that habitat type within the Project Area The greatest amount of long-term disturbance to a particular habitat type within the Forest Service Analysis Area would occur in riparian habitat (Alternatives 2 and 3 would disturb 1.5% of the riparian habitat within the Forest Service Analysis Area). This amount of surface disturbance would not adversely affect these species populations

as a whole due to the limited habitat impacts and mitigation measures, including nest surveys and spatial/seasonal buffers around nests.

Due to the relatively low surface disturbance to habitat, combined with mitigation measures aimed at preventing bird mortality by netting evaporative facilities, surveys prior to surface disturbance during the nesting season, buffering nests by 0.1 mile, the riparian mitigation measures for MIS bird species reducing impacts to some BCC and PIF priority species, and mitigation measures for sage grouse reducing impacts to sage brush obligate BCC and PIF priority species, it is determined that the Action Alternatives may impact individual birds, but would not affect the ability of the forest to provide habitat for these species and is unlikely to affect their populations.

3.9.2.10 Cumulative Effects

The CIAA for migratory birds is the Forest Service Analysis Area. This area is large enough to capture effects that may cumulatively affect wildlife on Forest Service lands (portion of the South Unit east of Hwy 191) as well as those impacts to wildlife on adjacent lands BLM and Tribal lands surrounding the Forest and the Project Area. Surface impacts in migratory bird nesting and foraging habitat within the Forest Service Analysis Area/CIAA is discussed above for each alternative. In summary, 1.5%, 1.7%, and 1.2% of available riparian habitat within the CIAA would be impacted by Alternative 2, 3, and 4, respectively For all other habitat types, less than 1% of available habitat would be impacted.

RFFAs that could impact migratory birds include oil and gas exploration and mineral resource extraction, road construction, recreation, wildlife habitat improvement, and livestock grazing. Past, present, and RFFAs regarding energy development projects (e.g., Vantage wells and oil and gas development on adjacent BLM and tribal lands) would be similar to the impacts described for this project and may have adverse effects to migratory birds. However, many of these projects are likely to have measures to minimize impacts to migratory birds. Also, as the mitigations (explained under the discussion of Alternatives for migratory birds) would minimize impacts from the project to migratory birds, it is likely that the project combined with these additional cumulative activities may impact some individuals, but would not affect migratory bird populations as whole. Also, some bird species are tolerant of human activities and may not be affected as easily as others.

Recreation impacts include hunting, camping, and firewood gathering. As the project is unlikely to increase recreation activities, it is likewise unlikely to increase impacts to migratory birds when combining the project with recreation activities. Past, present, and RFFAs for wildlife habitat improvement projects include prescribed burns and conifer encroachment projects. Prescribed burns within the CIAA include two projects totaling 3,200 acres; approximately 1,150 of the 1,200 acres of the Anthro Mountain target area have already been completed and no areas have been treated within the Antelope Canyon prescribed burn area. These burn areas are targeting dense sagebrush habitats (including isolated stands of aspen) with a canopy cover greater than 20%. Conifer encroachment projects that occur or are proposed within the CIAA consist of mechanical treatments to deter the encroachment of pinyon, juniper, and Douglas-fir trees into shrub communities. Although, there may be some short term impacts to some migratory bird species from these projects, the outcome benefits a variety of species in the long term, especially sage brush obligate species. Therefore, these habitat projects are unlikely to have long term impacts when combined with the project and mitigations associated with the project. The CIAA also contains almost 95,000 acres of cattle grazing allotments. Cattle grazing

Table 3-44. Surface Disturbance to Migratory Bird Habitat Types.

	Disturbance	Pinyon-Juniper Woodland	Sagebrush[1]	Riparian	Coniferous Forest	Brush-Lands[2]	Aspen Forest
Acres within Project Area		21,284	3,738	122	310	157	3
Acres within CIAA		101,804	53,563	584	9,498	6,874	1,352
Alternative 1 (No Action)	Short-term	0	0	0	0	0	0
	Long-term	0	0	0	0	0	0
Alternative 2 (Proposed Action)	Short-term	1,009 (4.7%)[3]	302 (8.1%)	15 (12.3%)	0	2 (1.3%)	0
	Long-term	443 (2.1%, 0.4%)[4]	127 (3.4%, 0.2%)	9 (7.4%, 1.5%)	0	1 (0.6%, 0.02%)	0
Alternative 3	Short-term	961 (4.5%)	337 (9.0%)	18 (14.8%)	0	2 (1.3%)	0
	Long-term	422 (2.0%, 0.4%)	140 (3.8%, 0.3%)	10 (8.2%, 1.7%)	0	1 (0.6%. 0.02%)	0
Alternative 4	Short-term	573 (2.7%)	225 (6.0%)	7 (5.7%)	0	2 (1.3%)	0
	Long-term	324 (1.5%, 0.3%)	115 (3.1%, 0.2%)	5 (4.1%, 0.8%)	0	1 (0.6%, 0.02%)	0

[1] Includes big sagebrush shrubland, black sagebrush, greasewood, and rabbitbrush habitats.

[2] Includes mountain brush habitat.

[3] Percent of habitat type within Project Area.

[4] Percent of habitat type disturbed. First value represents the percentage of the disturbance acres to the habitat type within the Project Area; second value represents the percentage of the disturbance acres to the habitat type within the CIAA/Forest Service analysis area.

activities associated with these allotments may reduce available foraging and nesting habitat, reduce available cover, impact riparian areas, and displace wildlife. However, grazing allotments on the Forest take wildlife needs into consideration and ensure there is a residual amount of forage for wildlife. Therefore, there would be minimal impacts to migratory birds, when grazing is combined with the project.

Based on the above rationale, the rationale under the Alternatives, and mitigations with the project, it is determined that combining cumulative impacts with the project may impact individual migratory birds, but would not affect the ability of the Forest to provide habitat for these species and is unlikely to affect their populations.

Table 3-45. Habitat Associations for BBC and PIF Priority Species.

Species	Pinyon-Juniper Woodland	Sagebrush and Brushlands[1]	Riparian	Coniferous Forest	Aspen Forest
Greater sage-grouse		x			
Golden eagle	x	x	x	x	x
Flammulated owl				x	x
Broad-tailed hummingbird	x		x	x	x
American three-toed woodpecker				x	
Gray vireo	x				
Pinyon jay	x			x	
Juniper titmouse	x				
Virginia‘s warbler	x	x		x	
Black-throated gray warbler	x	x			
Brewer‘s sparrow		x			
Sage sparrow		x			
Cassin‘s finch				x	

[1] Includes big sagebrush shrubland, black sagebrush, rabbitbrush, and mountain brush habitats.

3.9.2.11 Mitigation

- All open contaminated-water impoundments associated with drilling operations (such as reserve pits) would be covered with netting to prevent access by birds and toxic and contaminated water.
- Surveys for BCC and PIF priority species will be conducted prior to ground disturbing activities within the migratory bird nesting season (May 15–June 30). If any of these species are detected during the surveys, a nest search will be conducted. If nests are found or are suspected, then no ground-disturbing activities would be allowed from May 15–June 30 within 0.1 mile of the nest or estimated location of the nest.

3.9.2.12 Other Wildlife Species

The types of direct and indirect impacts to pronghorn would be the same as those for other big game, including habitat loss and fragmentation. The amount of crucial year-long and substantial year-long pronghorn habitat within the Project Area is 802 and 363 acres, respectively (or 3.1% and 1.4% of the Project Area, respectively). Table 3-46 provides the amount of disturbance to crucial and substantial year-long pronghorn range within the Project Area. If displacement of individuals does occur, it would be on a limited level due to the small amount of year-long range within the Project Area. Alternative 2 would impact 51 acres (6.4%) and 13 acres (3.6%) of crucial and substantial year-long pronghorn range in the Project Area. Alternatives 3 and 4 would impact 55 acres (6.9%) and 13 acres (3.6%) of crucial and substantial year-long pronghorn range in the Project Area, respectively. This is a relatively low percentage of habitat directly affected by surface disturbance, but road density and activities associated with the project could displace pronghorn from the Project Area. However, this habitat is located in the portion of the Project Area that is proposed for a lower density of well pads. This would decrease the chance of displacement. The Project Area is only 4% of the area within the Anthro Herd Unit (639,228 acres – boundary described at the beginning of the Cumulative Impacts Section). The amount of pronghorn habitat (crucial and substantial) within the Project Area would be less than 1% of this herd Unit. Therefore, although the project under the action alternatives may displace pronghorn out of habitat within the Project Area, it is unlikely to have much effect on pronghorn within the Herd Unit. Additionally, the winter timing stipulations for elk would also overlap crucial pronghorn habitat.

Table 3-46. Disturbance to Pronghorn Habitat by Alternative.

Range	Acres within Project Area	Alternative 1 (No Action)	Alternative 2 (Proposed Action)	Alternative 3	Alternative 4
Substantial year-long	363	0	13 (3.6%)	13 (3.6%)	12 (3.3%)
Crucial year-long	802	0	51 (6.4%)	55 (6.9%)	55 (6.9%)

Acres of Disturbance and (in parenthesis) the percentage of available habitat in the Project Area

Disturbed earthen material from the construction of well pads, roads, and pipelines may result in sediment entering waterways during intense storm events. Downstream ecosystems that support brown trout, flannelmouth sucker, and northern leopard frog would be negatively impacted if large amounts of sediments were input into the stream. These impacts would be associated with the number of wells and roads associated with each alternative; therefore the higher well pad numbers associated with Alternatives 2 and 3 would be expected to have greater sedimentation impacts on aquatic ecosystems compared to Alternative 4. However, BMPs would be used to control the movement of sediment from disturbed areas.

3.9.2.13 Cumulative Impacts

- The CIAA for pronghorn is the Anthro Pronghorn Herd Unit, which is the same as for elk and deer. This area was also selected for pronghorn CIAA to capture cumulative impacts within the Herd Unit. Since cumulative impacts to pronghorn would be similar to those for elk and deer, refer to the cumulative impacts discussion for elk and

deer. Based on the discussion for elk and deer, and the small size of the Project Area in relation to the Herd Unit, it is likely that the project combined with the cumulative impacts may affect pronghorn numbers, but would not substantially decrease the pronghorn herd within the Herd Unit. Mitigation

- No mitigation measures have been developed specific to mule deer; however, since elk and mule deer habitat overlap pronghorn habitat, those mitigation would also minimize impacts to pronghorn. The following mitigation measures apply to all alternatives.
- Well pad and road construction, road upgrades, work over rigs, and drilling operations would not be conducted between November 15 and April 30 to protect deer and elk winter range.
- Existing guzzlers present near proposed well pads would be reconstructed by the Operator in a new location away from well pads, in order to reduce the impacts of increased traffic and human presence on elk, mule deer, and other wildlife utilizing those structures for drinking.

Alternative 3 includes additional measures to protect migrating ungulates; minimize noise, traffic, and other construction-related activities in large portions of the Project Area; and limit sagebrush habitat fragmentation.

3.10 Livestock Grazing

3.10.1 Affected Environment

Livestock grazing is a primary land use of the Project Area, with nearly 100% of the Project Area part of a grazing allotment. The Project Area includes portions of five Forest Service cattle grazing allotments (Figure 3-21) that are permitted for 7,562 cattle AUMs. An AUM is the amount of forage required to maintain a 1,000-pound cow and calf less than six months of age, five sheep, or one horse for one month. The entire Project Area is used for grazing. Table 3-47 summarizes the permitted use for each grazing allotment within the Project Area. Suitable acres are the acres in the allotment that are determined suitable for livestock grazing by the ANF Rangeland Management Specialist(s). The number of suitable acres per AUM indicates rangeland productivity; a higher acreage required per AUM reflects poorer forage production amounts or quality. The reasons for lower forage production can include soil types, topography, or other natural factors. A lower acreage per AUM reflects higher productivity and more intense grazing. In most cases, the boundaries of the grazing allotments extend beyond the boundaries of the Project Area. Ten livestock operations have permitted use in these five allotments.

The Forest Service manages these allotments according to their individual Allotment Management Plans. Continued livestock grazing within all five allotments was recently reauthorized in Forest Service categorical exclusions (Forest Service 2006e, 2007g). These documents incorporate elements of the ANF adaptive management strategy, which are consistent with existing livestock grazing management and comply with current direction in the Forest Plan.

Table 3-47. Cattle Grazing Allotments within the Project Area.

Allotment Name	Season of Use	Total Allotment Area (acres)	Acres within Project Area	Suitable Acres	AUMs	Suitable Acres per AUM
Antelope	December 1 to March 23	23,879	8,481	5,292	994	5.32
Anthro Mountain	June 1 to October 15	22,293	12,652	5,292	994	5.32
Cottonwood	June 16 to October 15	6,516	1,034	4,565	1,751	2.61
Gilsonite	December 1 to February 14	7,704	517	3,724	2,057	1.81
Sowers Canyon	June 2 to October 1	8,488	2,674	3,104	1,766	1.76

3.10.1.1 Antelope Allotment

The Antelope allotment is permitted for 200 head of cattle from December 1 to March 23 (Forest Service 2001). Two permittees graze 200 head of cattle on this allotment (Forest Service 2007h). According to the Allotment Management Plan (Forest Service 2001), 100% of the allotment is in satisfactory condition, either at desired future condition (DFC) or trending toward DFC. No riparian areas are associated with this allotment. The suitable acres for grazing on this allotment are located in the canyon bottoms only (Helmus 2007).

3.10.1.2 Anthro Mountain Allotment

The Anthro Mountain allotment is located on Anthro Mountain between Sowers and Antelope canyons along the north slope of Reservation Ridge on the Tavaputs Plateau. Nutters Canyon, Brundage Canyon, and Wire Fence Canyon are the primary drainages within the allotment. These drainages are tributaries of Sowers Creek. No perennial streams are located within the allotment boundary. The allotment is permitted for two permittees to graze 481 cow-calf pairs from June 1 to October 15 (Forest Service 2004b). Two permittees graze 359 head of cattle on this allotment (Forest Service 2007i). All of the allotment is in satisfactory condition, either at desired condition or trending toward desired condition. Long-term studies indicate that ground cover and plant composition for upland vegetative communities are satisfactory and/or trends are upward or stable (Forest Service 2004b). The suitable acres for grazing on this allotment are located on top of Anthro Mountain (Helmus 2007).

3.10.1.3 Cottonwood Allotment

The Cottonwood allotment is located west-northwest of Anthro Mountain on the West Tavaputs Plateau. Cottonwood and Tabby canyons are the primary drainages within the allotment. Both are tributaries of the Duchesne River (Forest Service 2006f). Two permittees graze 326 cow-calf pairs from June 16 to October 15 (Forest Service 2007j). Based upon approximately 122 different study sites located throughout the allotment, the plant communities grazed by livestock are in satisfactory condition with stable trends or

are trending toward desired condition (Forest Service 2006f). Within the allotment, cattle graze on tops of ridges and in canyon bottoms near water sources (Helmus 2007).

3.10.1.4 Gilsonite Allotment

The Gilsonite allotment is located east of Anthro Mountain on the West Tavaputs Plateau. Gilsonite Draw, which is a tributary of the Duchesne River, is the primary drainage within the allotment. There are two grazing units within the Gilsonite allotment—North Gilsonite and South Gilsonite. One permittee is permitted to either graze 275 cow-calf pairs from December 1 to March 1 or 1,000 head of sheep from November 15 to March 31 annually (Forest Service 2006g). The actual use for the allotment is 150 head of cattle from December 1 to February 14 (Forest Service 2005b).

The suitable acres for grazing on this allotment are located in the shallow drainages and chained pinyon and juniper openings (Helmus 2007). Based on approximately 98 different study sites located throughout the allotment, the plant communities grazed by livestock are in satisfactory condition with stable trends or are trending toward desired condition (Forest Service 2006g).

3.10.1.5 Sowers Canyon Allotment

The Sowers Canyon allotment is located west-northwest of Anthro Mountain on the West Tavaputs Plateau. Sowers Creek is the only perennial stream within the allotment, which is a tributary of the Duchesne River. Three permittees graze 294 cow-calf pairs from June 2 to October 1 annually. Based on approximately 217 different study sites located throughout the allotment, the plant communities grazed by livestock are in satisfactory condition with stable trends or are trending toward desired condition (Forest Service 2007k, 2007l). Cattle graze primarily in the canyon bottoms. Occasionally, cattle graze halfway up the ridges and travel into the Anthro Mountain allotment (Helmus 2007).

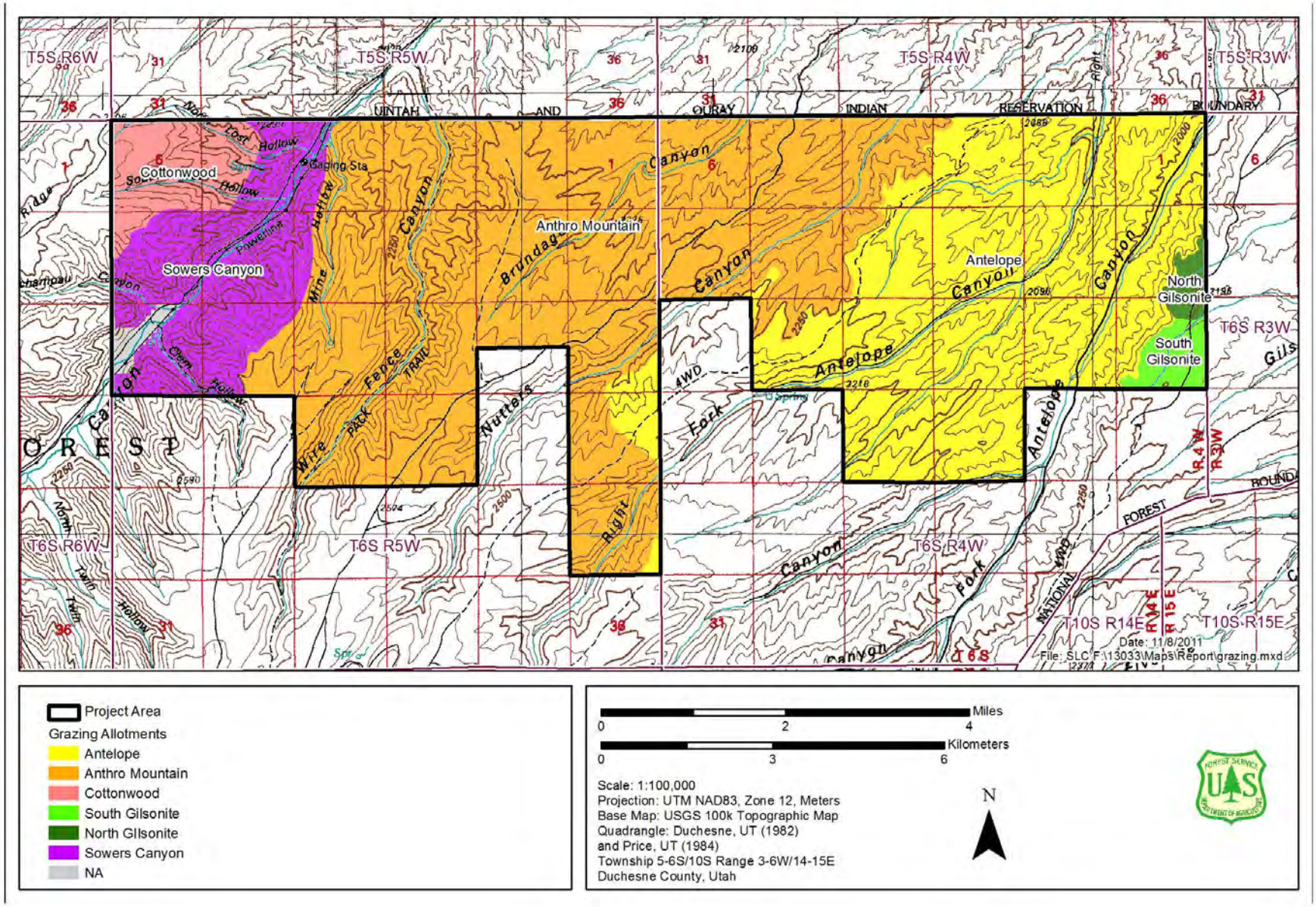


Figure 3-21. Grazing Allotments within the Project Area.

3.10.2 Environmental Consequences

3.10.2.1 Direct and Indirect Impacts

Impacts to rangeland health, livestock grazing, and other rangeland resources would result from implementation of the Proposed Action or Alternatives 3 and 4. In particular, fish, wildlife, and livestock depend on rangeland health for food and habitat. The impacts on fish and wildlife are discussed in Section 3.9. The intensity of rangeland impacts would mainly depend on the extent of vegetation and soil disturbance, amount of traffic (i.e., dust and animal/vehicle collisions), and success of reclamation including weed control.

Under the Proposed Action and all alternatives, cattle grazing would continue throughout the duration of the project with stocking rate adjustments and requests for temporary non-use made annually by each livestock operator. Potential livestock management impacts include reclamation failures, loss of functions of rangeland improvements, loss of palatability of vegetation from road dust, and livestock losses from vehicle collisions. Impacts would occur from vegetation and soil disturbance associated with construction activities, reclamation, weed control, road construction and use (i.e., dust and animal/vehicle collisions), and rangeland improvements functionality.

The primary impact to grazing resources would be short-term loss of available forage as a result of construction and production-related disturbance. Available forage would be reduced during drilling and construction phases but would be reclaimed as soon as feasible for the production phase. A long-term loss of forage would occur due to construction of roads and ancillary facilities that remain in place during the LOP. Dust from roads reducing the palatability of adjacent vegetation and the threat of health issues such as dust pneumonia could also be impacts to livestock from field development activities, in addition to the effects associated with direct loss of vegetation.

The potential exists for disruptions to livestock management actions. There is also potential for damage to range improvements from the movement of heavy trucks, drilling equipment, and heavy construction equipment. Traffic along roads that pass through active shipping pastures or corrals could interrupt or complicate this work, extending the time and increasing the cost to complete it. Cattle guards and gates could be damaged by drill rigs that are too wide/heavy, leading to added maintenance and unwanted mixing of livestock. Direct loss of livestock is possible if vehicle collisions and the resulting mortality increase with field development.

Disturbance of soils and increased vehicle activity would increase the introduction, establishment, and spread of undesirable non-native/noxious weed species. This can reduce forage availability and animal weight gains, in addition to affecting trail routes and overall animal health. Proper reclamation of disturbed sites would help reduce these potential impacts. Potential short-term and long-term impacts to AUMs on the grazing allotments within the Project Area are presented in Table 3-48.

3.10.2.1 Alternative 1 – No Action Alternative

Continued activities under the No Action Alternative would result in no new disturbance to grazing allotments other than that which was previously authorized.

Table 3-48. Impacts to Grazing Allotments within the Project Area (in Acres).

Disturbance Type	Antelope	Anthro Mountain	Cottonwood	Gilsonite	Sowers Canyon
Alternative 1 – No Action Alternative					
Drilling and Completion	0	0	0	0	0
AUMs Affected	0	0	0	0	0
After Interim Reclamation	0	0	0	0	0
AUMs Affected	0	0	0	0	0
Alternative 2 – Proposed Action					
Drilling and Completion	454	701	62	25	109
AUMs Affected	85	131	24	14	62
After Interim Reclamation	187	310	29	12	51
AUMs Affected	35	58	11	7	29
Alternative 3					
Drilling and Completion (for all phases combined)	455	697	63	26	104
AUMs Affected	85	131	24	14	59
After Interim Reclamation	187	308	30	12	49
AUMs Affected	35	58	12	6	28
Alternative 4					
Drilling and Completion	308	395	31	17	75
AUMs Affected	58	75	12	9	43
After Interim Reclamation	158	224	19	10	47
AUMs Affected	30	42	7	6	27

3.10.2.2 Alternative 2 – Proposed Action

The Proposed Action would result in an estimated initial disturbance to allotments of about 1,361 acres from well pads, access roads, and gathering pipelines. This represents about 5% of the total land area of the grazing allotments within the Project Area. The majority of surface disturbance (approximately 701 acres) under the Proposed Action would occur in the Anthro Mountain allotment. Successful interim reclamation would replace forage removed from short-term disturbances. Reclamation of short-term disturbance would probably compensate for a portion of the forage lost. However, this is dependent on commitment by the Operator for successful reclamation and weed control. During the LOP, this disturbance would be reduced to 589 total acres, or about 2.3% of the combined land area of the allotments within the Project Area.

Reseeding of allotments with perennial forage grasses would occur within the next growing season. Revegetation of the allotments is dependent on many factors including soil moisture, precipitation, soil type, and a number of other environmental correlates. Revegetation is expected to commence within one year of disturbance and no long-term reduction in quality of current grazing allotments would be expected, as long as an appropriate seed mix is used for interim reclamation of well pads, access roads, and pipelines.

3.10.2.3 Alternative 3

Under this phased development alternative, overall disturbance to grazing allotments would be nearly the same as the Proposed Action; however, impacts would be spatially distributed across the Project Area and temporally distributed over the 5- to 20-year drilling phase. This would reduce impacts to allotments at any one time as reclamation would occur immediately following well completion. Successful interim reclamation would replace forage removed from short-term disturbances. Reclamation of short-term disturbance would likely compensate for a portion of the forage lost. As a result, there would be more forage available for livestock and wildlife over the LOP than there would be if the entire disturbance took place at once. Table 3-49 summarizes disturbance to grazing allotments per phase.

3.10.2.4 Alternative 4

The total surface disturbance under this alternative is reduced compared to the Proposed Action, and distribution of disturbance across allotments is altered (Table 3-48). The collocation of wells on fewer well pads would result in decreased surface disturbance from roads in the Project Area. The number of access roads and gathering pipelines would be reduced compared to the Proposed Action, which would provide a larger area suitable for livestock grazing. It would also reduce the potential for introduction of noxious and invasive weeds along roadsides and would reduce indirect adverse impacts from fugitive dust on forage.

Table 3-49. Impacts to Grazing Allotments within the Project Area from Alternative 3 (in Acres).

Disturbance Type	Antelope	Anthro Mountain	Cottonwood	Gilsonite	Sowers Canyon
Phase 1					
Drilling and Completion	252	3	0	26	0
AUMs Affected	47	1	0	14	0
After Interim Reclamation	105	1	0	8	0
AUMs Affected	20	0	0	4	0
Phase 2					
Drilling and Completion	203	89	0	0	0
AUMs Affected	38	17	0	0	0
After Interim Reclamation	82	40	0	0	0
AUMs Affected	15	8	0	0	0

Disturbance Type	Antelope	Anthro Mountain	Cottonwood	Gilsonite	Sowers Canyon
Phase 3					
Drilling and Completion	0	261	0	0	0
AUMs Affected	0	49	0	0	0
After Interim Reclamation	0	111	0	0	0
AUMs Affected	0	21	0	0	0
Phase 4					
Drilling and Completion	0	175	0	0	0
AUMs Affected	0	33	0	0	0
After Interim Reclamation	0	79	0	0	0
AUMs Affected	0	15	0	0	0
Phase 5					
Drilling and Completion	0	92	63	0	83
AUMs Affected	0	17	24	0	47
After Interim Reclamation	0	43	30	0	40
AUMs Affected	0	8	12	0	23
Mule Deer Crucial Summer					
Drilling and Completion	0	53	0	0	0
AUMs Affected	0	10	0	0	0
After Interim Reclamation	0	24	0	0	0
AUMs Affected	0	5	0	0	0
Mule Deer Crucial Winter					
Drilling and Completion	0	25	0	0	21
AUMs Affected	0	5	0	0	12
After Interim Reclamation	0	11	0	0	9
AUMs Affected	0	2	0	0	5

3.10.3 Mitigation

In addition to mitigation measures recommended to minimize impacts to vegetation and soils, mitigation measures are recommended to protect range resources. Additional measures could also be applied to protect the resources as needed, as determined by the AO.

The following measures could be applied to protect range resources.

- Fence well pads, as needed and as determined by the Forest Service, to prevent cattle from entering well pad areas.

- Repair all fences damaged by or removed for construction.
- Avoid range improvements such as stock ponds, guzzlers, and other watering amenities, where possible.
- As mitigation for the initial temporary loss of AUMs, use of a reclamation seed mixture that complies with Forest Service standards should continue to be implemented in the Project Area.
- Reduce fugitive dust from roads by employing speed limits, watering, and other means.

3.10.4 Cumulative Impacts

The grazing CIAA is the combined area of five grazing allotments that are either wholly or partially located within the Project Area. Impacts from this and other RFAs would be similar to the impacts from the proposed project and include vegetation and soil disturbance associated with construction activities, reclamation, weed control, road construction and use (i.e., dust and animal collisions), and rangeland functionality. Long-term, cumulative impacts would likely include a small net loss in total annual forage production from road construction and other permanently maintained areas. Assuming that successful revegetation occurs, this decrease in quantity would be partially offset by temporary increases in quality, provided by younger, more nutritious herbaceous vegetation. Lower vegetation palatability from dust cover and the threat of health issues such as dust pneumonia could potentially create more significant impacts on grazing livestock than the effects associated with direct loss of vegetation.

Disruptions to livestock management, damage to facilities, and direct mortality of animals due to collisions and ingestion of non-native poisonous plants are impacts that are more serious concerns for the livestock ranches throughout the grazing CIAA. With each new development in the CIAA, these impacts would be compounded by density of development and could potentially affect the viability of the industry in the region.

With proper consultation and stipulations set forth by the responsible agencies, effects of these issues can be minimized in the Project Area and throughout the grazing CIAA. In particular, animal death loss can be minimized through adherence to standard traffic stipulations and an adequate weed reduction and management program.

In addition to the factors mentioned above, the level of impact on livestock would depend on the rate and extent of development in the grazing CIAA and in the Project Area. Each allotment would be affected differently. At times, often because of market and production requirements, oil and gas development occurs at a rapid pace and some impacts to grazing animals would be unavoidable during this phase. However, once development is completed, long-term cumulative impacts would be reduced to affects from increased traffic and small-scale activities associated with maintenance of existing facilities. During the production phase livestock grazing would likely return to previous levels of use.

3.11 Cultural Resources

3.11.1 Affected Environment

The term Cultural Resources refers to archaeological, traditional, and built environment resources, including, but not necessarily limited to, buildings, structures, objects, districts, and sites. Not every object or feature that might be considered a cultural resource necessarily requires study. Certain properties can be so minor or fragmentary or

ubiquitous that they lack the potential for significance as defined within Section 106 of the NHPA. At the same time, it is essential to be aware that not all potentially significant cultural resources are visible or apparent prior to conducting technical studies or consultations. Archaeological resources may be buried, without surface features, or inconspicuous to the untrained eye. At the same time, sites of important events, traditional cultural places, or places associated with an important person may lack obvious physical characteristics. Importantly, it is not always a simple matter to identify and evaluate cultural resources that could possess historical significance and that therefore require consideration under federal and state laws and regulations.

This section does not present an exhaustive culture history of the Project Area, although it is clear that it has ~~"a~~ unique and interesting archaeological record" that differs from that of the Uintah Basin and the Uinta Mountains to the north, and that of Nine Mile Canyon to the south (Loosle 2007). Evidence from the South Unit of the ANF indicates that it has been subject to human activities for at least the last 4,100 years (Johnson and Loosle 2002; Loosle 2007). Moreover, recently discovered evidence from the Anthro Mountain Burn Survey of 2007 includes several artifacts that are typologically associated with the Late Paleoindian period, and thus, the duration of human occupation in this area is undoubtedly much longer than indicated by radiocarbon dates alone, although the local environment and vegetation would have been quite different (Loosle 2007).

3.11.1.1 Cultural History Overview

As noted by Loosle (2007), comprehensive reviews of previous research, theoretical approaches, comparisons of culture histories, a review of the environmental history, and discussion of site types in northeastern Utah have been provided by Spangler (2002, 1995). This overview section does not duplicate those reviews, but focuses more specifically on the South Unit of the ANF and site types in the region. The overview is divided into several main sections, with each addressing a major subdivision of the region's culture history sequence. A summary of the culture history sequence for the area is presented in Table 3-50. The overview is primarily derived from Loosle (2007) and the references cited therein.

Table 3-50. General Culture Sequence for the ANF South Unit (after Loosle 2007).

Cultural Era	**Paleoindian**	**Archaic**		**Formative**			**Late Prehistoric**
		Early Archaic	**Late Archaic**	**Fremont**			**Numic**
South Unit	No Data	Possible	No Data	Early Agricultural	Middle Agricultural	No Data	Ute
Timeline	10,000 BC?	4,000 BC		500 BC	AD 550	AD 1050	AD 1600

Paleoindian Period

Loosle (2007) notes that prior to 2007, no Paleoindian artifacts or occupation had been documented in the South Unit. Since that time, a Cody knife and several large lanceolate points have been located at sites discovered during 2007 surveys. The sites are located in the upper elevation sagebrush steppe and may be similar to other Late Paleoindian sites known from west-central Colorado. Prior to these finds there were only a few surface finds of Paleoindian artifacts in the Uintah Basin and no buried or stratified sites have been excavated. Some researchers (Simms 1988; Spangler 2002) suggest that there may be little difference between Early Archaic and Paleoindian manifestations in the region.

One proposed explanation for the lack of sites was a presumed focus on major river tributaries. The discovery of these sites in the South Unit despite the lack of major tributaries would contradict this hypothesis. If the focus was only on the minor tributaries that are present within the South Unit, it was assumed that their occupational deposits would be deeply buried and subject to discovery only under fortuitous conditions. The recently discovered sites are located on ridge tops, generally overlooking springs, and as a result, the region may have stratified sites that are available for further investigation.

Archaic Period

An important difference between the Archaic of the Uintah Basin region and that found in the Uinta Mountain foothills is that the latter shows significant changes in both settlement patterns and subsistence strategies between the Early and Late Archaic periods. Early Archaic occupations are represented by warm-season pithouses with storage pits, and subsistence appears to have focused on a broad-spectrum hunting adaptation with a slight preference for medium to large game. A variety of plant resources were used as well, but as yet no evidence of seed storage or processing has been found. Loosle (2007) notes that between 4100 and 2000 BP, slab-lined roasting ovens were constructed to cook a variety of plant foods. Foothills populations were apparently comprised of highly mobile small family groups. The end of the Late Archaic is apparently marked by some form of climatic event, since all known occupations between 2500 and 200 years ago in the Uintas were in rockshelters. The terminal Archaic provides the first evidence of seed consumption and storage pits become important again (Johnson and Loosle 2002). It is argued that because the South Unit is an upper elevation area, it may have some similarities to the Uinta Mountains, although expectations are that it would have been exploited differently due to climatic factors or local cultural traditions. In addition, it is expected that there will be discernable difference in the archaeological record between the Early and Late Archaic and Fremont periods in the South Unit.

Early Archaic

Severe drought conditions characterize much of the Early Archaic period, so it is expected that some evidence for occupations will be found in the upper elevations of the South Unit. The current lack of water in the area is thought to have been even more pronounced during the Early Archaic and may have been a critical limiting factor. The lack of documented sites of this period therefore is not surprising. It has been noted that although a few points of the Pinto, Elko Series, and Northern Side-notch varieties have been recovered from the South Unit, none of these are exclusive to the Early Archaic, so their presence alone is not convincing evidence of early human occupation (although see recent evidence for possible Late Paleoindian occupations listed above). Discovery and excavation of stratified sites with Early Archaic levels are needed.

Late Archaic

As argued by Loosle (2007), the use of a Middle Archaic designator in the region is not warranted by the currently available data. Instead, a single Late Archaic phase from ca. 4000 B.C. to ca. 500 B.C. is proposed, similar to that for the Uinta Mountains (Johnson and Loosle 2002). This phase is correlated with changes in climate which in turn resulted in shifts in local lifeways. In the South Unit, this is represented by an amelioration in climate and a return to cooler and wetter conditions which would have resulted in an increased abundance of resources. This is evidenced by an increased emphasis in upland use after ca. 2650 B.C. reflecting a change in adaptive lifeways. The earliest radiocarbon date for the South Unit is reported by Loosle (2007:12) as 4120 Cal BP, with dates

becoming common after 2800 Cal BP. The majority of Late Archaic radiocarbon dates from the Uintah Basin and the South Unit come from rockshelter sites, and there is a paucity of architecture during this period, with basin-shaped pits and hearths being the only Late Archaic features identified. It is important to note, however, that rockshelters do not represent the entire seasonal round of the Late Archaic, and the inhabitants would have operated within a regional setting that would have included a number of settlements throughout the year. A problem with data recovery from rockshelters is the disturbance or obliteration of earlier deposits by later occupations. Due to this subsequent site use, pits and hearths are isolated and are only rarely associated with use surfaces and artifacts.

Nonetheless, some information on Late Archaic occupations has been recovered. They seem to indicate brief stays during the warm season (summer through fall) in temporary camps. Subsistence consisted of a mixed selection of animals and plants, and at some sites there appears to have been an emphasis on hunting medium and large mammals (Stertz and Loosle 2006). An increased emphasis on large game appears to have been a regional pattern. Importantly, maize pollen has been found in nearly all South Unit Late Archaic features, although at some it is undoubtedly the result of contamination through rodent burrows. A date of 390 Cal B.C. was recovered from one hearth, suggesting early maize exploitation (Stertz and Loosle 2006). Plant gathering was also important as evidence by macrobotanicals also recovered from hearths, however without any precedents, it is not clear what trend or pattern the grass and cheno-am processing at Late Archaic South Unit sites represent.

Formative Era

Early Agricultural Period

Loosle (2007) identifies the work of Talbot and Richens (2004) as providing the most reasoned and appropriate Formative Era culture history for northeastern Utah. The term Early Agricultural period refers to the time during which agriculture was practiced, but no ceramics were produced. It marks the transition from a mobile hunter-gatherer lifeway to a more sedentary existence reliant on horticulture along with an increased complexity of material culture and a higher frequency of imported goods. The term ―Early Basket maker" has been largely discarded by modern researchers in the Uintah Basin region, mainly because it implies cultural migration from the Southwest rather than the in situ development of a Later Archaic cultural tradition.

The beginning of the Early Agriculture period is not as clear cut since the introduction of new technologies is not as well defined. While a date of A.D. 1 was proposed by Talbot and Richens (2004), they also note a significant increase in population by 500 B.C. The material record suggests a gradual accumulation of new technologies. The introduction of the bow and arrow (particularly as represented by Rose Spring style points), maize, storage features, and the intensive processing of cheno-am seeds may be most representative of this way of life. It is probable that during this period some groups were committed horticulturalists while other neighboring groups were mostly dependant on wild resource exploitation. In general, a number of technological and subsistence innovations occurred sometime after 500 B.C. and before A.D. 550, which ultimately resulted in a full-blown Formative Society. Whether the Uintah Basin Fremont represents an in situ development, migration, or combination of factors remains unresolved. Early dates from South Unit sites suggest that data which could help address these questions may be available in this region (Loosle 2007).

Middle Agricultural Period

Northeastern Utah is marked by a classic Fremont fluorescence between A.D. 550 and A.D. 1050 with all aspects of an agricultural society being present. These include pithouse architecture; trough-shaped metates and two-hand manos; large bell-shaped storage pits; elaborate rock art; an apparent elaboration in personal adornment; a large increase in the amount of exotic goods including salt water shells; abundant maize, pumpkin, and bean remains; water diversion features; and a significant increase in population (Talbot and Richens 2004). This period is the most studied and best documented of the prehistoric eras in the region and it is the best-represented era in the South Unit. However, while farming is a defining characteristic of the Fremont, it needs to be considered within a broader landscape approach to occupations in the region. Patterns of radiocarbon dates for the region from the peak at around A.D. 700 to 800, through to the drastic decline around A.D. 1050 and even the near abandonment between A.D. 1200 to 1600 imply that they represent the same population practicing a mixed economy (Loosle 2007). Since it is located between two Fremont core areas, the South Unit is an ideal area to study Fremont mobility and seasonal rounds.

In the Uinta Mountains during the Fremont period, the upland occupants were clearly tethered to lowland locations as evidenced by the presence of maize, ceramics, and other artifacts (Loosle and Johnson 2003). Annual fall forays into the uplands to gather a few abundant reliable resources helped to augment cultigens produced in the lowlands. The annual pattern of mixing collection of wild and domesticate resources was so successful that it permitted these Fremont groups to persist long after the demise of the Fremont in the larger, more agriculturally dependant villages in the Uintah Basin and the rest of Utah. It was initially hypothesized that the South Unit would display the same logistical pattern as the Uinta Mountains, however, the excavated sites to date have shown a markedly different pattern. Data suggest that while a high elevation residential site has been identified, the area is dominated by a number of brief occupation sites and the South Unit has produced the first unequivocal evidence from northeastern Utah that pinyon nuts were gathered for consumption. In at least two other sites, two kinds of cheno-am seeds were gathered and processed together (Stertz and Loosle 2006). It is possible that the South Unit occupations represent evidence for Fremont forager groups.

The gathering of cheno-am and pinyon nuts suggests the rockshelters were occupied in the fall, like the Uinta Mountain sites, possibly after the harvest. The majority of these sites are in the eastern end of the South Unit, adjacent to the early historic route through Gate Canyon. It is possible that they represent a prehistoric travel route between Nine Mile Canyon and the Uintah Basin. The brief stays and gathering of resources for immediate consumption would both be characteristic of travelers.

Other possible cause for these visits could be reflected by ceremonial remains. A number of unusual rock outlines or features along the South Unit‘s southern crest may mark vision quest locations. Trade may also be a factor, since Tiger chert from quarry sites in Wyoming, Uinta quartzite, and Uinta grayware ceramics, all from the Uintah Basin have been found on South Unit sites, although few of these items are found farther south in Nine Mile. In addition, there is some obsidian in the South Unit, but little analysis has been conducted to determine its source. Pottery is another possible exchange item and ceramics have been found at a small number of sites in the South Unit. All are Uinta Gray and they are not common enough to suggest any substantial movement of pottery between the Uintah Basin and Nine Mile. Except for a few Emery Gray vessels in the Uintah Basin and a small amount of Uinta Gray ceramics in Nine Mile, there is little to suggest

exchange between the two areas. Except for ceremony, there appears to be little reason for farmers to be traveling into the South Unit (Loosle 2007).

Loosle (2007) summarizes this period by noting that although physically closer to Nine Mile Canyon, the South Unit sites have dominant ties to the Uintah Basin. Numerous pieces of Uinta quartzite ground stone, even metates, and lithic material from north of the Uintas (Tiger chert, Sheep Creek quartzite) have been found which illustrates this connection. South Unit Fremont pottery is all Uinta Gray, including a sherd from the Anthro Mountain site that has identical paste and temper to a sherd found near Flaming Gorge Dam over 70 km away (Estes and Loosle 2001). It has been observed that Nine Mile Canyon does not have particularly distinctive cultural attributes or material culture, except for architecture and rock art. Except for hearths and a few storage pits, no Fremont architecture has been documented in the South Unit. Similarly, the rock art of the South Unit is not particularly helpful in assigning cultural affiliation. Only a few panels have been discovered to date, over half of which are Ute. A large anthropomorph appears to be typical Classic Vernal (northern) style, while the other figures do not fit neatly into any recognized style. Consequently, it is not clear how influence from Nine Mile Canyon would manifest in the South Unit. Understanding why the influence of groups from the Uintah Basin was so dominant needs further investigation.

Late Agriculture Period

Talbot and Richens (2004) have described a late occupation that may involve movement of people away from the interior of the Uintah Basin and a possible small population of non-farmers who were coresident in the eastern Uintah Basin. A slight increase in radiocarbon dates after A.D. 1300 would mark this period. A similar post-A.D. 1300 Fremont period has been proposed for northwestern Colorado. These individuals who practiced a mixed economy combining domesticates with annual forays to gather wild resources were more resilient to climatic changes and were able to persist longer. Since no evidence of the northern logistical strategy has been found on the South Unit, it is not surprising that evidence of a Late Formative occupation is also missing.

Numic Era

Many archaeologists see a distinct cultural difference between the Fremont and Numic groups, while a few others argue for continuity. As in the Uinta Mountains to the north (Johnson and Loosle 2002), the South Unit contains surface evidence of a Numic occupation; however, no radiocarbon dates or excavated features can be ascribed to this period. There is not enough information to divide the period into any categories, although some have attempted divisions based on acquisition of the horse or other technologies or rock art styles. Some Ute rock art panels exist in the South Unit, the most obvious being of mounted figures or those wearing elaborate Plains headdresses. There is no clear support of Numic occupation before the reservation period, although there is abundant evidence of historic activity (Loosle 2007).

Ethnohistoric Data

Loosle (2007) notes that there is essentially no historical documentation that the Ute visited the South Unit, however six sites with diagnostic Ute artifacts (Desert side-notched points and Intermountain brownware pottery), Ute style rock art sites, culturally modified trees, and brush drivelines have been recorded. Information for the region from Ute elders has been sparse. Jorgensen (1964) emphasizes the importance of big game hunting in pre-reservation Ute culture, even before the arrival of the horse. Today, the South Unit is

known for the quality and quantity of its big game, and hunting is the predominant activity in the area.

Fowler (2002) lists a number of plant foods that were consumed by the Ute, and several are available in the South Unit. Pinyon nuts were an important resource and would have been plentiful in the South Unit. The only evidence for Fremont consumption of pine nuts in northeastern Utah comes from sites in the South Unit. However, to date, none of the sticks, basketry, or other cultural items associated with nut harvesting have been found (Loosle 2007). Small seeds from grasses, sunflowers (Eriophyllum sp.), amaranth (Amaranthus sp.), Indian ricegrass (Oryzopsis hymenoides), greasewood (Sarcobatus vermiculatus), and globemallow (Sphaeralcea sp.) would have also been available and the pottery and ground stone that dates to the Numic period may represent collection and processing of these resources. Chokecherries, elderberries, buffaloberries, service berries, currants, and strawberries would also have been gathered, although the scarcity of perennial water in the South Unit would have limited availability. Although hunting and gathering may have been common activities in the South Unit, other dominant archaeological sites types that have been documented are culturally modified trees, brush drivelines, and corrals. Moreover, these last two features are not always obvious, even to trained archaeologists who might not be familiar with the region or the resource, and consequently it is important that cultural resource personnel are made aware of them. Loosle (2007:31–42) provides an extensive and detailed description of these properties as they are represented in the South Unit, and provides important details for distinguishing Ute and Anglo resources.

Ute History

Rather than attempting to summarize in detail the Ute and Anglo history of the South Unit, Loosle and Boren (2007) focus on some of the most salient issues and activities that may have occurred in the area. The South Unit appears to have been sparsely populated during the Historic period, and not all areas were occupied or used equally. The Ute bands were closely associated with the distribution of the coniferous forests and the large game animals and horses which these areas supported. Ute groups would have a home territory through which they moved in a regular pattern. They would move to higher elevations during the summer and to lower elevations during the winter and would move to particular locations to gather specific resources or to perform rituals. Most of the logical routes the Ute would have followed to travel in and out of the Uintah Basin probably did not pass through the South Unit.

Warfare seems to have been a significant factor that limited occupation of the Uintah Basin during the early historic period. When Dominguez and Escalante traveled through the Uintah Basin in 1776, they noted fighting between the Comanche and Ute, and that the Ute had been forced to abandon the Uintah Basin due to the threat.

Fur Trade

Following the brief visit by the Spanish, fur trappers were the next Europeans to enter the Uintah Basin. It is doubtful that the remains of the brief forays during trapping episodes will ever be found, and the streams were undoubtedly quickly emptied of beaver if the trappers ever entered the South Unit. The relatively dry South Unit does not have many perennial streams. Any trapper incursions would have occurred on the western end on tributaries of the Strawberry River such as Timber and Beaver canyons. Historic accounts suggest there may not have been many beaver in any case and the area may not have

attracted trappers. Spangler (2002) lists a number of explorers, trappers, and others who passed just beyond the south end of the South Unit.

Reservations

President Lincoln set aside the Uintah Valley Reservation on October 3, 1861. Congress confirmed the reservation on May 5, 1864, however Congress never approved the treaty that was signed by O.H. Irish, the Superintendent of Indian Affairs for Utah and several Ute chiefs. Efforts began in 1862 to move the Ute to the reservation, but they were reluctant to leave their fertile areas when so little awaited them in the desert. Because of the near starvation condition of many of the Ute during this period, they engaged in the theft of cattle and horses in order to help feed the destitute. Sharp engagements often occurred during these raids as militia chased retreating raiders. There is frequent mention of Ute coming to the reservation and going back to central Utah, however, the route they used to travel between the different areas is not specified. Although they may have crossed the Tavaputs or even the South Unit during these trips, this is only speculation. They probably stayed on well known paths away from the South Unit. In 1872 Chief Douglas from the White River Band visited the reservation and ridiculed the individuals who were attempting to farm. He was able to persuade some members to ―leave with him for a visits and council some point south" (O'Neal 1973:105). However, no clear indication is given of where the ―point south" was located.

In 1905, President Theodore Roosevelt removed 1,004,285 acres from the reservation and transferred them to the Uinta National Forest. This acreage included all of the South Unit and portions of the Uinta Mountains. In 1908 the ANF was created from the eastern portion of the Uinta National Forest and the South Unit became part of the ANF leaving a checkerboard pattern of jurisdiction, portions of the South Unit are therefore considered Indian country. Once many of the Utah Utes had relocated to the Uintah Reservation they faced a variety of problems, not the least of which was starvation. Plagues of grasshoppers as well as corrupt or incompetent agents made life on the reservation very tenuous. This caused many of the Ute to leave the reservation or to travel to upper elevations to hunt, gather, or visit frontier settlements for provisions. ―It was not until 1878–1879, when the Ute hunting areas were depleted and their population decimated, that they began to stay for more than half of the year on their reservation" (Jorgensen 1964:91). Thus, the period between 1878 and 1905, when the South Unit was removed from the reservation, probably marks when most of the physical evidence from Ute activities (corrals, drivelines, and culturally modified trees) was created. In spite of this movement, no mention is ever made of the different routes that were used by the Ute as they came and left the reservation.

Grazing

The first clear documentation of activity in the South Unit begins with the Anglo cattlemen. ―Cattle herds likely ranged through the area in the 1870's and did throughout eastern Utah. The Midland Trail, which was well established by the late 1860's passed within two miles of the (Nine Mile) canyon…" (Spangler 1993:437). Preston Nutter was one of Utah's biggest cattle barons. In the early 1890's he was able to secure a large lease of pasture land (665,000 acres) on the reservation. Although most of Nutter's operation was not in the South Unit, his presence was still felt and history records that Nutter had built structures and fence lines on the west side of Sowers Canyon and that he was ultimately found guilty of grazing trespass in the forest (Jorgensen 1964). Cattle grazing continues to be an important activity in the South Unit. Some of the existing cattle camps probably once belonged to illegal cattlemen or to Preston Nutter's men. Most of the South

Unit permits issued by the Forest Service between 1916 and 1937 were for grazing activities (corrals, fences, spring developments, etc.).

Homesteading

Reservation lands were opened to the public in 1905. A lottery system was instituted to proportion the lands and over 37,000 individuals applied. In total, 5,772 names were drawn and they were charged $1.25 an acre, just as the Utes had paid. Interestingly, 1905 had above average precipitation and when severe droughts started in 1906 many of the homesteaders quickly abandoned the Uintah Basin (Fuller 1990). A number of private holdings exist in the bottoms of some canyons, such as Indian and Sowers. A search of the Duchesne County Records Office shows that all of these were patented between 1911 and 1920. Homes, barns, corrals, and other developments were built on many of these homesteads. Although many of these private lands still support livestock or hay production, families no longer live on any of them. Alfalfa crop failures in 1923 caused some families to leave the county (Barton 1998), which was part of a nation-wide trend to leave farms and head to cities. Most of the local homesteads were vacated at this time, although a small number were occupied as late as the 1940's. In essence, any homesteading activity likely to be encountered in the South Unit is nearly a century old and should be treated accordingly (Loosle and Boren 2007).

Roads and Other Activities

In 1884 and 1885, a road was built south to the city of Price through Nine Mile Canyon, just missing the South Unit. ―The route through Nine Mile Canyon to the railroad in Price was deemed the best route by the army. For the army‘s needs none of the existing roads provided what Nine Mile offered: the shortest distance from Fort Duchesne to a railroad, a more moderate grade, and a low pass through the Roan and Book Cliff Mountains. It was so heavily used for twenty years that the road was aptly named the ‗Lifeline of the Uintah Basin’” (Barton 1998:71). Barton also notes that an alternative route was the Indian Canyon road, which became popular briefly following the construction of the Denver and Rio Grande Railroad track through Carbon County in 1883. A shorter route from Castle Gate to Duchesne through Indian Canyon was improved in 1919–1920 and became the primary mail route into the Uintah Basin (Spangler 1993). Forest Service crews have located a myriad of roads near the top of Indian Canyon. A number of overlapping and interlocking routes built at different times has created an intricate complex of corridors. These roads vary from barely discernable wagon roads to well made gravel roads with wood fences and high embankments. Short sections of a particular road can be assigned a period of use because of tree inscriptions or associated artifacts. The confusing alignments and super positioning of the roads will require considerably more effort to fully decipher.

―Sawmills at various locations, including Indian Canyon, Tabiona and John Starr Flat above Neola, were in place by 1906-07” (Barton 1998:119). There is no clear indication of where the Indian Canyon sawmill was located, but it was probably in the forest since there is limited timber lower in the canyon. Robert Krebs was issued a permit for a sawmill in 1924 that was associated with his travel stop on the left fork of Indian Canyon.

Predator control has always been an issue for stockmen in Duchesne County, and poison, along with trapping, was used heavily at the turn of the century. From March 20, 1915, to March 20, 1916, bounty was paid by Duchesne County on 18 bears that were killed. The federal government also employed professional trappers at this time to curb predation (Barton 1998). Nearly all the rockshelters in the South Unit have evidence for trapping. In one overhang an Ashley Heritage crew found the business card of a federal trapper that

was more than 30 years old. William Barton and other ranchers talk about their efforts to remove wolves and other predators from the area (Loosle and Boren 2007).

Summary

It can be reasonably argued that the South Unit has been subject to more or less continual occupation and utilization through historic times and perhaps as far as 9,000 or more years in the past. Each period of culture history presents its own suite of material culture and lifeways to be investigated, and each requires its own set of specific research questions. Nonetheless, this brief overview of the South Unit‘s culture history should provide a context for evaluating the possible effects from the Proposed Action.

3.11.1.2 Known Sites Inventory

At this time only some 21% of the Project Area has been subject to surface inventory for cultural resources and consequently, it is not possible to accurately map their distribution. Moreover, as is detailed below, some depositional environments (such as valley bottoms) may have sites that were once on the surface but are now buried by sediments, and as such, these resources would not be discovered even if surface surveys were performed.

Even with the incomplete cultural resources inventory within the Project Area, it is still necessary to develop some measure of the resources that are potentially present if project effects are to be assessed. Two major objectives were identified in order to address this issue. The first was to evaluate those cultural resources that have been recorded thus far within the Project Area, to compare them with those that have been identified within the ANF South Unit in general, and in that way, determine to what degree they are representative of the broader region. The second objective was to examine various aspects of the landscape and environment that are associated with the known sites in order to develop a ―sensitivity model” which has some predictive value in estimating where cultural resources are most likely to be encountered and consequently, in which portions of the Project Area impacts to cultural resources are most likely to occur. It must also be recognized that all portions of the Project Area should be considered to have at least some potential to contain cultural resources, no matter where they are located. For this reason, even areas that are ultimately ranked as having ―Low” sensitivity should still be subject to close scrutiny.

As of January 2007, 170 archaeological sites had been recorded within the totality of the South Unit (Loosle 2007). This number certainly has been exceeded as of the time of this writing, but the relative proportions and types of sites are unlikely to have changed significantly. In order to provide a sense of the general nature of the archaeological record in this region, it is appropriate to review the types of archaeological resources that have been recorded in the South Unit as a whole and then to focus on those resources that have been recorded within the Project Area specifically.

Of those 170 recorded sites within the ANF South Unit, 31 (18.2%) have historic components and 153 (90.0%) have prehistoric components, with 14 of these sites being multicomponent. The site types included 120 lithic scatters, 24 rockshelters, nine corral sites, three cabin sites, three prehistoric lithic quarry sites, three historic trash scatters, three historic campsites, one fireplace, one guard station, one prehistoric hunting blind, one tin can scatter, and one reported historic trail. Several culturally modified trees also have been recorded by avocational archaeologists, but lack formal Intermountain Antiquities Computer System site records or Global Positioning System (GPS) positions and have not been incorporated into the heritage database. The South Unit as a whole

comprises 202,123 acres and as of January 2007, only 17,629 acres (8.7%) had been subject to on-the-ground reconnaissance (Loosle 2007). Of this, only 3,354 acres (1.7%) have received intensive-level survey (15-meter transects or less). Nonetheless, using the gross area surveyed results in a site density of approximately 6.2 sites per square mile.

As reported in Loosle (2007), one site, the Indian Canyon Guard Station, is listed on the National Register of Historic Places (NRHP), while an additional 84 sites (49.4%) are considered eligible. Of the remaining sites, 71 (41.8%) have been determined to be not eligible and 14 (8.2%) sites remain unevaluated, however, for management purposes they would be considered eligible until they can be formally examined. The vast majority of sites (90%) have been recorded on ridge tops, or on ledges, terraces, and cliffs near the tops of ridges. Only 17 (10%) of these recorded sites have been documented in the valley bottoms of the region (Loosle 2007), and these are predominantly historic. The prehistoric sites that have been recorded in the valley bottoms include five lithic scatters, three of which have historic components, one rockshelter, and one quarry site. As noted by Loosle (2007), it is doubtful that the valley bottoms were sparsely populated prehistorically, rather, it is more likely that the highly erosive sediments in the region may have buried many of the earlier sites, or that limited survey in this topographic setting could have biased the results. Loosle (2007) has observed that, in at least one area, cultural differences or activities appear to have dictated site placement. In the lower end of Nutters Ridge (south of the Project Area), twentieth century cattle camps are located in valley bottoms, while late nineteenth century Ute wild horse corrals are on ridge tops. This pattern has not been observed in any other portion of the South Unit.

Moreover, sites appear to be focused within a limited number of vegetation zones. Basically 125 (74%) sites within the general South Unit are in pinyon-juniper woodland. Three sites which were described as having grass vegetation are probably located in cleared areas within the woodland. Thirty-seven sites (21.8%) are in sagebrush, including one in rabbitbrush, and represent high-elevation sagebrush steppe and low-elevation sagebrush in the valley bottoms. Loosle (2007) identifies only five sites (2.9%) that represent occupation beyond the sagebrush and pinyon-juniper, with two in aspen and three in mixed conifer zones. However, three of those five sites are historic, and historic sites have the most varied site placement. While the preponderance of past Forest Service management activities have occurred in the pinyon-juniper belt, and consequently might have been thought to have biased identification of sites, Loosle (2007) notes that recent prescribed burns, as well as surveys associated with oil and gas development, have demonstrated that relatively few prehistoric sites have been identified beyond this vegetation type. Clearly, there was a preference for this vegetation type/landscape setting by the prehistoric inhabitants of the region, and this was likely related to available resources such as pinyon, and likely affected the seasonality of occupation as well. Importantly, the eastern South Unit (including the Project Area) is distinctive, whether from topography or orientation, in that the pinyon-juniper zone is expansive and extends well beyond the typically associated elevation. It is still unclear to what degree these factors may have influenced prehistoric occupation.

In developing a sensitivity model for the Project Area, and hence assessing potential effects from the proposed undertaking, it is important to determine to what degree it reflects the overall patterns of the South Unit as described above. Of the 76 known sites that are either wholly contained within the Project Area or intersected by the Project Area boundary, 71 are located on ridge tops or away from the valley bottoms. In the valley bottoms, there are three prehistoric sites, one historic site, and one site with both historic and prehistoric components. These data suggest that site-associated topography within the

Project Area is consistent with patterns observed throughout the South Unit and prehistoric sites are strongly correlated with ridge top settings, and to a lesser degree with the valley bottoms. Multicomponent sites are more varied in their settings, although only one has been recorded in any proximity to the major valley bottoms. Finally, while four of the five recorded historic sites are located on ridges or uplands, one historic site is located directly on a valley bottom.

Site distributions with relation to vegetation zone also appear to follow the general patterns that have been described for the South Unit. The Project Area is dominated by pinyon-juniper woodland, with the next largest zones comprising big sagebrush and black sagebrush shrublands (Figure 3-15). Within the Project Area, 61 sites (80%) are located within pinyon-juniper woodland with an additional four sites located in mixed habitat of pinyon-juniper and big sagebrush (totaling 85% of all sites). All eight multicomponent sites, and four of the five single component historic sites, are located in the pinyon-juniper zone. Ten of the remaining prehistoric sites are located in either big sagebrush or black sagebrush, although one of these is adjacent to coniferous forest. Only one site (historic) is located out of the pinyon-juniper/sagebrush zones, and this is also one of the few sites located off of the ridges. It is situated in a mountain brush/grassland habitat.

Available data indicate that of the 25,900 acres in the Project Area, approximately 5,330 acres (20.6%) have been surveyed for cultural resources, producing a somewhat higher average site density of 9.1 sites per square mile compared to the 6.2 sites per mile recorded for the South Unit as a whole. It is likely that the higher number for the Project Area reflects the greater proportion of survey performed with 15-meter transects.

Taken together, these data confirm that the Project Area is consistent with the South Unit as a whole in terms of site location trends with regard to topography and vegetation. It now remains to identify which environmental characteristics might be used in order to provide the strongest predictors for developing a sensitivity model for the region. In looking at known sites within the Project Area, the correlations with vegetation are clear. In order to quantify ―ridge tops," however, it is necessary to use the related measures of slope, aspect, and elevation associated with the known sites in order to generate a synthetic measure of site location relative to these topographic features.

One component that has not been used in this analysis is distance to water. Previous studies have failed to identify significant correlations with water in this region (Johnson 2007) and a likely explanation is contained within the Project Area‘s topographic setting itself. The multiple and regularly spaced drainages dissecting the Project Area (Figure 3-14), all trending in a southwest to northeasterly direction, apparently provide an essentially homogenous background for this resource, such that no single canyon is able to generate significant ―pull" relative to the others. Available data on spring locations within the Project Area also were not used since only one of the six spring locations had any immediate proximity to a known (historic) site, while one other spring was over 0.25 mile distant from another historic site, but even farther from the nearest mapped prehistoric site. Two of the remaining four springs were within previously surveyed areas but were not associated with sites, while the areas surrounding the remaining two springs had not been subject to archaeological survey.

Table 3-51 shows the four layers that were used to generate the sensitivity model map. These include vegetation, slope, aspect, and elevation and have been largely derived from known site locations within the Project Area.

One assumption of this modeling strategy is that the population of known sites in the Project Area is an accurate reflection of all sites that exist within the region. It also does not offer predictors on the locations of buried deposits, although as has been discussed above, it is likely that the valley bottoms possess as yet unidentified buried cultural resources. Quaternary alluvial (Qal) sediments identified in Figure 3-11 would be the most suitable zones to test for buried cultural deposits.

The results of the modeling process are presented in Figure 3-22. The Project Area has been mapped by sensitivity rating based on the criteria listed in Table 3-52, as well as through an interactive weighting process tested against known sites, whereby slope was ultimately given a 40% input to the rating score, while vegetation, elevation, and aspect were assigned 20% each.

Table 3-51. Sensitivity Ratings for Identifying Surface Cultural Resources.

Resource Criteria	Sensitivity Level	Comments
Vegetation: Pinyon-Juniper woodland and Big or Black sagebrush shrubland **Slope**: 0–15% **Elevation**: 2,219–2,400 meters (m) above mean sea level (amsl) **Aspect**: 330–83° True **Distance to improved springs**: ≤1,500 m	High	Principal landforms are the ridges in the Project Area. Elevations essentially bracket ridge features. The predominant northeast aspects relate to ridge orientation and reduced summer isolation. May relate to summer harvest of pinyon. Minimal spatial restrictions on site expansion.
Vegetation: Coniferous forest **Slope**: 16–30% **Elevation**: >2,400 m amsl **Aspect**: 84–155° and 263–329° True **Distance to improved springs**: >1,500 and ≤3,400 m	Medium	Principal landforms include southwestern portions of ridges. Elevations extend above high sensitivity zones. Aspects include east-southeast and west-north exposures.
Vegetation: Other **Slope**: >30% **Elevation**: < 2,219 m amsl **Aspect**: 156–262° True **Distance to improved springs**: >3,400 m	Low	Landforms principally include lowest portions of valley bottoms. Slopes in excess of 30% (approaching 20 degrees) are avoided. Aspect has maximum exposure to summer insolation, but may be restricted by topography.

Table 3-53 presents the acreages and percent coverage for each of the High, Medium, and Low ratings as they were defined based on this model, while Table 3-54 examines the proportionate areas of known cultural resource sites within the Project Area that are captured within each rating. Table 3-54 shows the same data as a percent of all sites within that rating level. Thus, while 41.03% of all single-component historic sites were captured within the High sensitivity rating, these represent only 8.3% of the acreage of all sites (now including multicomponent and prehistoric sites) that were captured by the High sensitivity rating in general (i.e., they are slightly under-represented, since overall, known historic sites represent 15.34% of all sites by acreage). Conversely, 85.90% of known prehistoric site acreage was contained within the High sensitivity rating (with 13.90%

prehistoric site acreage ranked as Medium and only 0.20% ranked as Low) and known prehistoric site acreage represents 85.10% of all site acreage contained within the High sensitivity ranking. This indicates that the sensitivity model as developed here is principally an indicator of the potential surface presence of prehistoric sites. This is not surprising since it is reasonable to expect that different variables may well have affected the selection of either historic or prehistoric sites as well as their subsequent discovery due to their depositional environment.

Total acreages for known sites rather than simple counts were used to evaluate the capture success of each rating level, since the area covered by a site is to some degree a better measure of the relative abundance of materials that are present. However, this is not meant to imply that a large-area site is necessarily more important or contains more information than a smaller area site, but rather is simply a measure of the spatial footprint. It should be noted that 35 prehistoric sites in the reference data collection (17 recommended eligible to the NRHP, 17 recommended not eligible, and one unevaluated) had been recorded only as point locations, without additional spatial data. These sites were arbitrarily assigned a site radius of 15 meters (100-foot diameter) in order to provide proxy data for the spatial evaluation. This results in a calculated site area of approximately 0.18 acre. Of the 28 prehistoric sites with known areas, and excluding three sites which were extremely large outliers, the median prehistoric site area was approximately 0.60 acre. Consequently, the total prehistoric site area, and the proportionate area of all sites captured within the High sensitivity rating, is likely an underestimation.

Table 3-52. Project Area Coverage by Sensitivity Rating.

Rating Level	Acres	%
High	6,294.5	24.30
Medium	18,397.0	71.03
Low	1,208.5	4.67
Total	**25,900**	**100**

Table 3-53. Estimated Total Known Site Acreage and % by Rating Level.

Rating Level	Historic		Multicomponent		Prehistoric		Rating Total	
	Acres	%	Acres	%	Acres	%	Acres	%
High	8.94	41.05	7.10	52.13	91.57	85.90	107.61	75.78
Medium	12.18	55.92	6.51	47.80	14.82	13.90	33.51	23.60
Low	0.66	3.03	0.01	0.07	0.21	0.20	0.88	0.62
Total	**21.78**	**100**	**13.62**	**100**	**106.60**	**100**	**142.00**	**100**

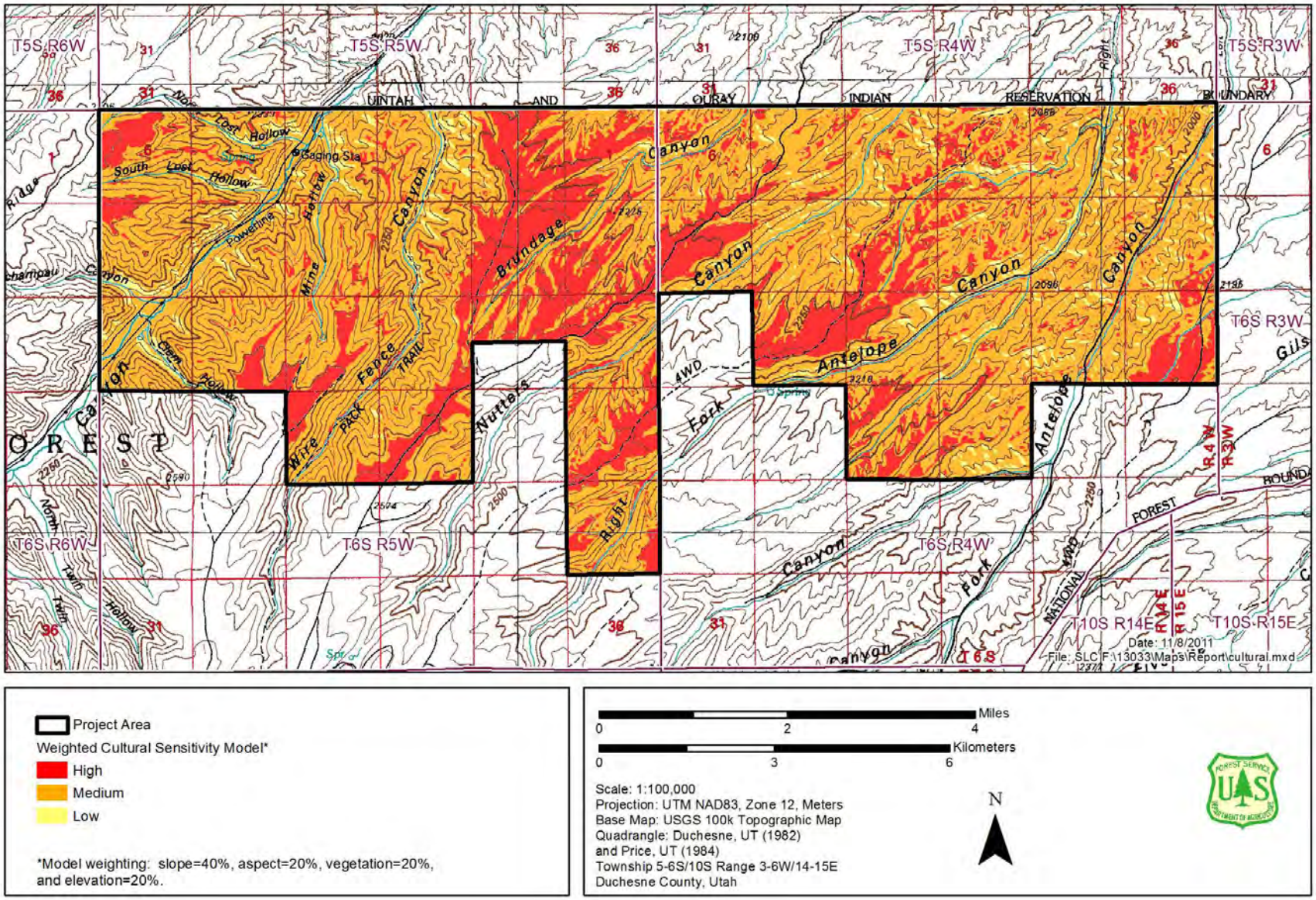


Figure 3-22. Mapped Results of the Cultural Resources Sensitivity Model.

Table 3-54. Known Site Acreage as a % of All Sites by Rating Level.

Rating Level	Historic		Multicomponent		Prehistoric		Rating Total	
	Acres	%	Acres	%	Acres	%	Acres	%
High	8.94	8.31	7.10	6.60	91.57	85.10	107.60	100
Medium	12.18	36.35	6.51	19.43	14.82	44.23	33.51	100
Low	0.66	74.16	0.01	1.12	0.21	23.60	0.89	100
Total	**21.78**	**15.34**	**13.62**	**9.59**	**106.60**	**75.06**	**142.00**	**100**

3.11.2 Environmental Consequences

The loss, such as through destruction or looting of any NHRP-eligible historic property (including both historic and prehistoric resources) which possessed the quality of significance in American history, architecture, archaeology, engineering, or culture, and which also possessed integrity of location, design, setting, materials, workmanship, feeling, and association would be an adverse environmental impact. Adverse effects to these non-renewable cultural resources primarily concern their removal or destruction, and the concomitant loss of information associated with them.

3.11.2.1 Impacts Common to All Alternatives

Any actions that have the potential to disturb surface or subsurface deposits may have direct effects on cultural resources. Structures or construction associated with the actions (e.g., drilling rigs, pump stations, pipelines, or access roads) have the additional potential to affect both historic and prehistoric sites where visual integrity of setting is a component of their eligibility to the NRHP. This can include, but is not limited to, prehistoric rock art sites, historic inscription sites, traditional resource gathering or processing areas, and historical trails, roads, or structures. This may also include visual impacts to Traditional Cultural Properties (TCPs). Increases in well densities, with concomitant increases in the densities of structures or construction associated with the support infrastructure will increase potential effects to cultural resources. Resource impact indicators would include total acreages of well pads and associated production facilities, linear miles of road construction, and linear miles of pipeline construction. Visual impacts would use similar metrics extrapolated to identify properties within the viewshed.

Ground-disturbing activities form a major component of each alternative, except for the No Action Alternative. The Proposed Action certainly has the potential to adversely affect cultural resources in the Project Area, although the greater the reduction in number of well pads and the linear miles of roads or pipelines, the greater the reduction in direct effects. Since one of the strongest predictors of site location (slope) is also an important consideration for well pad placement, it is quite likely that areas targeted for well pads, compressor stations, their associated access roads, and pipelines, would have a high probability of encountering archaeological sites. This is especially true in the High and Medium sensitivity areas. Moreover, these effects would impact both surface and buried deposits. It is anticipated that Quaternary alluvial (Qal) deposits in the Project Area will have the greatest potential for containing buried cultural resources. Visual impacts to cultural resources are possible where integrity of setting is a component of a site‘s NRHP eligibility. This would include any identified TCPs. Estimated acreage of disturbance by

sensitivity area is presented in Table 3-55. For the purposes of this table, a 50-foot-wide road disturbance corridor is assumed, which would include associated pipelines.

Table 3-55. Estimated Disturbance within Sensitivity Level.

Rating Level	Type	Alternative 1 (Existing) Acres	Alternative 2 Acres	Alternative 3 Acres	Alternative 4 Acres
High	Compressors	0	4	4	4
	Roads	221	473	469	401
	Well Pads	20	321	359	175
	Total	**241**	**798**	**832**	**580**
Medium	Compressors	0	12	12	12
	Roads	240	559	542	402
	Well Pads	29	568	546	292
	Total	**269**	**1,139**	**1,100**	**706**
Low	Compressors	0	0	0	0
	Roads	19	41	41	34
	Well Pads	3	46	30	26
	Total	**22**	**87**	**71**	**60**
Total		**532**	**2,024**	**2,003**	**1,346**

3.11.2.2 Direct and Indirect Impacts

Direct Impacts

Direct impacts include the potential for site destruction (even allowing for data recovery excavations prior to the construction activities). Direct and/or indirect impacts would occur under all alternatives and correlate directly to the amount (acreage and depth) of surface disturbance in areas that contain surface or subsurface cultural resources. As a result, the diversity and quantity of intact cultural resources within the South Unit will be irrevocably and irretrievably reduced. In general, as a result of construction and production, it is most likely that direct adverse effects to cultural resources which require mitigation would occur under the Proposed Action and Alternatives 3 and 4.

The direct effects would be mitigated through intensive surveys of areas subject to disturbance, identifying and documenting observed resources (including the potential for either moving construction and production facilities, or performing data recovery of the resources such as through excavation). The recommended mitigation measures (see below) would recover some of the value of these resources that would otherwise be destroyed by surface and subsurface ground-disturbing activities. However, it is also probable that data which cannot currently be recovered by available techniques (e.g.,

possible new ways of dating sites, new ways for determining patterns of subsistence and seasonality) may be destroyed as a result of this action and consequently, will be unavailable for analysis under any condition. The guiding principles of identification, recording, and avoidance as described below should remain a central objective under the Proposed Action and Alternatives 3 and 4, with a comprehensive Research Design and Treatment Plan developed for any subsequent data recovery undertaking.

Indirect Impacts

Under any of the proposed action alternatives, well pads, access roads, gathering pipelines, and production facilities would be distributed throughout the Project Area. This represents a significant increase in human presence and future access and will have a potentially significant impact on NRHP eligible archaeological sites that have a surface manifestation even if they are not directly affected by well pad, road, pipeline, or production facility construction. Specifically, this increased presence and associated access to the area provided by road construction will result in the significantly increased threat of vandalism, looting, or unintentional destruction of archaeological sites not only during the course of well production, but for as long as the associated access road network is in place.

As noted previously, available data suggest an average site density throughout the Project Area of over nine sites per square mile. Sites are undoubtedly to be concentrated on those landforms with reduced slope, such as ridge tops and valleys, which unfortunately, are also the preferred locations for well pads, roads, pipelines, and production facilities.

In addition, natural landscape features and areas can be significant to Native American tribes for cultural and spiritual reasons, as are traditional resources harvesting and processing areas and archaeological sites. As such, visual, auditory, and other impacts from well development under the Proposed Action and alternatives may substantially degrade the integrity of setting, feeling, and association of any TCPs identified within the Project Area. This would apply even to TCPs not directly affected by well, road, pipeline, or facilities construction. These are not impacts that can be easily quantified, but they are potentially to be of major concern to consulting tribes.

3.11.2.3 Alternative 1 – No Action Alternative

In the case of the No Action Alternative, there would not be any increased direct impact on cultural resources; however, ongoing natural processes such as erosion and sedimentation or human-caused impacts such as looting would continue. Moreover, since the greatest majority of the Project Area has yet to receive intensive surface inventory for cultural resources, these areas would remain unsurveyed and the resources would remain unrecorded. Nonetheless there would be no additional visual impacts to sites where integrity of setting is a component of the site‘s NRHP eligibility. Any identified TCPs would be similarly unaffected.

The No Action Alternative would retain the existing disturbance as a result of the wells which are currently present in the Project Area. There are 241 acres of disturbance in High sensitivity areas as defined by the model, as well as 269 acres of disturbance in Medium sensitivity areas and 22 acres of disturbance in Low sensitivity areas.

3.11.2.4 Alternative 2 – Proposed Action

This alternative would drill up to 400 wells using a combination of new and existing well pads, in the Project Area and would produce the greatest likely impact to existing cultural

resources both known and unknown. It would require the most intensive levels of action to document cultural resources as well as to mitigate the effects of the action. High well pad density would also limit options for avoiding sites and could require more intensive treatments such as data recovery excavations in order to mitigate adverse effects. Well pads, compressor stations, roads, and pipelines located in valley bottoms would have the greatest potential for impacting buried cultural resource deposits. Burial of pipelines may reduce visual impacts but would greatly increase the potential for disturbance of surface and subsurface cultural resources. The Proposed Action would also have the greatest visual impacts to any TCPs identified within the Project Area, both during the construction of wells and infrastructure as well as during production.

Under the Proposed Action, well development would cumulatively contribute to approximately 798 acres of disturbance within zones with High sensitivity for cultural resources (assuming a 50-foot corridor of disturbance for roads and associated pipelines). Zones with Medium sensitivity for cultural resources would experience approximately 1,139 acres of disturbance, while Low sensitivity areas would have only 87 acres of disturbance.

3.11.2.5 Alternative 3

This alternative would have similar overall impacts as the Proposed Action, although the option of limiting well density in areas with the highest sensitivity for cultural resources could limit adverse effects based on surface distributions of known cultural resources. It could have unchanged effects upon buried cultural resources. Well pads, roads, and pipelines located in valley bottoms would have the greatest potential for impacting buried cultural resource deposits. Restriction of well pads to slopes less than 25% would likely increase the potential for impacting known and unknown cultural resources. Burial of pipelines could reduce visual impacts but would greatly increase the potential for disturbance of surface and subsurface cultural resources. With a phased approach there likely would be a reduced visual and auditory impact at any one time, while the cumulative visual impacts from long-term structures would be equivalent to the Proposed Action. Temporary impact to TCPs would also be incremental, with the cumulative impacts being equivalent to the Proposed Action.

Alternative 3 would produce 832 acres of disturbance in High sensitivity areas, 1,100 acres of disturbance in Medium sensitivity areas, and 71 acres of disturbance in Low sensitivity areas.

3.11.2.6 Alternative 4

Under this alternative, the number of well pads would be reduced to 162 well pads with an average of four well pads per section. Well pads can be up to 3 acres each to accommodate multiple wells. Total LOP surface disturbance from well pads, roads, pipelines, and facilities is estimated at 1,346 acres. As a consequence of the reduced surface disturbance and number of well pads, the potential impact to surface and subsurface cultural resources would be less than the Proposed Action or Alternative 3. This alternative would reduce the miles of new access roads and gathering pipelines. Lower well pad densities increase possible options for shifting well pad locations and avoiding impacts to cultural resources. Well pads, compressor stations, roads, and pipelines located in valley bottoms would have the greatest potential for impacting buried cultural resource deposits. Burial of pipelines could reduce visual impacts but would greatly increase the potential for disturbance of surface and subsurface cultural resources.

Temporary visual impacts to cultural resources such as TCPs would be reduced, as presumably would long-term impacts from production facilities.

Alternative 4 would produce 580 acres of disturbance in High sensitivity areas, 706 acres of disturbance in Medium sensitivity areas, and 60 acres of disturbance in Low sensitivity areas. Impacts to cultural resources for all alternatives are summarized in Table 3-56.

3.11.3 Cumulative Impacts

The CIAA for cultural resources is the project area and all pipeline routes and roads proposed for this project. In general, under all alternatives, impacts to cultural resources within the Project Area would be reduced if mitigation measures as described below were implemented. Nonetheless, it is also the case that inadvertent or unavoidable impacts to cultural resources, both direct and indirect, will also occur to cultural resources within the Project Area, and will therefore contribute to the cumulative impacts to cultural resources in the region. The recommended mitigation measures would recover data of significant value to science and society that would otherwise be destroyed by project-related ground-disturbing activities or impacted through increased human presence. These actions may even result in the recovery of data which may otherwise remain undiscovered, but it can be reasonably assumed that at least some loss of resource will occur. The proposed project will, therefore, contribute at least in some degree to cumulative impacts to cultural resources in the region. Table 3-56 shows the summary of impacts.

3.11.4 Mitigation

The NHPA of 1966 as amended and its implementing regulations (36 CFR 800) require the Forest Service to take into account the effects of undertakings on federal lands by reviewing undertakings, identifying ―Historic Properties," assessing the effects of the project, and resolving or mitigating adverse effects. The NHPA also requires the Forest Service to provide the Utah State Historic Preservation Officer (SHPO) an opportunity to comment on the proposal and consult with concerned Native American tribes prior to project implementation. The NHPA consultation would also include a designated representative from the Ute Tribe.

The Forest Service has determined that the Proposed Action would have an adverse effect on Historic Properties and has developed a Programmatic Agreement (Agreement #AS-11-00017) to specify the Section 106 process for the project. Cultural resource identification efforts and tribal consultation are outlined in the Programmatic Agreement and include the following guidelines for the proposed project.

- The Stipulations of the Berry Petroleum South Unit Programmatic Agreement (Agreement # AS-11-00017) will be fully implemented in order to fulfill the requirements of Section 106 of the National Historic Preservation Act and to avoid, minimize, or mitigate adverse effects to National Register eligible cultural sites affected by the project.
- Ground-disturbing activities (road construction and upgrading, well pad construction, pipeline placement, etc.) will not be authorized until cultural resource identification
- and avoidance procedures have been completed as specified in the Berry Petroleum South Unit Programmatic Agreement (Agreement # AS-11-00017).

- The Cultural Resource Monitoring Plan as specified in the Berry Petroleum South Unit Programmatic Agreement (Agreement # AS-11-00017) will be implemented to evaluate indirect and cumulative effects of the project on cultural resources.
- All personnel, subcontractors, and consultants associated with the project will refrain from collecting, damaging, or impacting cultural resources on the Forest.

Table 3-56 Summary of Impacts

Alternative 1 (No Action)	**Alternative 2 (Proposed Action)**	**Alternative 3**	**Alternative 4**
No impacts to cultural resources beyond those that occur due to existing uses of the area. Management of cultural resources in the ANF South Unit would continue at the discretion of the ANF archaeologist.	Maximum potential impact to known and unknown cultural resources with 1,361 acres of LOP surface disturbance. Sites not directly impacted by well field development would be subject to indirect effects from vandalism, looting, or unintentional destruction over the LOP. Native American TCPs would be subject to adverse effects to their integrity of setting, feeling, and association due to visual, auditory, or other effects from well field construction activity over the 55-year LOP.	Maximum potential impact to known and unknown cultural resources with 1,355 acres of LOP surface disturbance. Phased approach may allow for more comprehensive data recovery prior to well field construction. Restriction of well pads to slopes of less than 25% could increase the likelihood of impacting both known and unknown cultural resources. Native American TCPs would be subject to adverse effects to their integrity of setting, feeling, and association due to visual, auditory, or other effects from well field construction activity over the 55-year LOP. Phased approach could limit duration and intensity of adverse effects to Native American TCPs outside of areas currently under development or that are actively in production.	Reduced potential impacts to known and unknown cultural resources with reduced number of well pads resulting in 836 acres of LOP surface disturbance. Reduced numbers of well pads may increase potential for avoidance of cultural resources when encountered. Native American TCPs would be subject to adverse effects to their integrity of setting, feeling, and association due to visual, auditory, or other effects from well field construction activity over the 55-year LOP. Adverse effects to Native American TCPs would be reduced in proportion to the restricted number of well pads proposed.

- If cultural resources are inadvertently discovered, construction activities will be halted within 100 feet of the discovery and the Forest Service notified. Operations in the area of the discovery will not resume until stipulations of the Forest inadvertent discovery plan have been fulfilled and the authorization to proceed has been received from the Forest Service.
- A qualified paleontologist will monitor construction activities for proposed well pads and their access roads if potentially fossil bearing shallow or exposed bedrock is present. If significant paleontological resources are discovered, construction activities will be halted in the immediate area and the Forest Service notified. Operations in the immediate area of the discovery will not resume until authorization to proceed has been received from the Forest Service.

Identification Efforts

Cultural resource identification efforts for this project will include archaeological pedestrian survey of all proposed pipelines, well pads, and other ground-disturbing activities. Inventory will consist of pedestrian surveys performed by qualified archaeologists using a 15-meter maximum transect spacing. Identification efforts will include a minimum inventory width of 90 meters (300 feet) on all roads and a minimum inventory of 40 acres for all well pads. Most identification efforts and project reports will be prepared by qualified contract archaeologists funded by the project proponent. Reports will be reviewed by the Forest Service and submitted for SHPO comments and tribal consultation.

Avoidance

Avoidance of cultural resources will be a priority of this project and will follow the ―Standard Avoidance Protocols" outlined in the Programmatic Agreement. Whenever possible, project activities will avoid sites by maintaining a 30-meter (100-foot) buffer between sites and roads and maintaining a 45-meter (150-foot) buffer between sites and well pads. Project roads and well pad locations will be moved wherever possible to meet these requirements.

Mitigation Strategies

In cases where the project cannot be modified to meet avoidance buffer protocols, the Forest Service will resolve the adverse effects as outlined in the Programmatic Agreement. The nature and location of the site will be compared to the Proposed Action and the Forest Service will determine if the effects will be direct or indirect.

Indirect Effects

Indirect effects include unplanned, inadvertent, or cumulative effects to the cultural resources because of increased roads and access to the area. Indirect effects could include an increase in off-road vehicle traffic on sites or an increase in artifact collection near roads or well pads. Sites that are likely to be indirectly impacted by the project will be periodically monitored as indicated in the Programmatic Agreement Monitoring Plan. Monitoring activities will be conducted by qualified contract archaeologists funded by the project proponent. If damages or unauthorized collecting threaten to impact the integrity of the cultural resources, the resources will be mitigated under one of the direct effect mitigation strategies outlined below.

Direct Effects

Direct effects include ground-disturbing activities within the site boundary, or planned repetitive activities which will affect or impact the integrity of the cultural resource. In situations where cultural resources will be directly affected by the project, one or more of the following mitigation strategies will be selected after consultation with the Utah SHPO and concerned tribes. Mitigation strategies will be determined by the Forest Service but will be conducted by qualified contract archaeologists funded by the project proponent.

- Complete archaeological excavation and data recovery. The cultural resource to be affected will be excavated through approved archaeological methods and the data from the site recovered and documented. The information from the excavation will be published in an approved format and made available to the public and the archaeological community.
- Selective archaeological excavation and data recovery. The Forest Service will consult with the Utah SHPO and concerned tribes to determine the level of archaeological excavation desired. This option is a triage approach that allows the Forest Service to focus time and resources on those sites that likely contain the most significant information about the prehistory of the area, rather than spending equal time and resources on sites of different significance.
- Alternative mitigation approaches proposed by the Forest Service on a site-by-site basis and agreed to by the Utah SHPO and concerned tribes.

Cultural Resources Consultation

The Forest Service has consulted with the Utah SHPO, the Advisory Council on Historic Preservation, the Utah Professional Archaeological Council, and the Ute Indian Tribe in regards to potential effects to cultural resources and has developed a Programmatic Agreement to outline the process for completing the requirements of the NHPA.

Native American Tribal Review

The Forest Service has consulted with the Ute Indian Tribe and will continue to consult with Native American Tribes on identification efforts, avoidance procedures, and mitigation strategies as required by 36 CFR 800. Tribal consultation is described in detail in the project record.

3.12 Recreation

3.12.1 Affected Environment

Recreation resources within the Project Area are characterized by remote, vast open spaces with dispersed undeveloped recreation opportunities typical of eastern Utah plateau and canyon country. The level of recreational visitation in the Project Area is low. Outstanding opportunities exist for experiencing solitude, remoteness, and the challenge of backcountry experiences within the Project Area as there are no developed recreation sites or facilities. Visitors pursue their activities in a setting that provides for a range of experiences from remote backcountry (semi-primitive non-motorized) to roaded natural settings. More detailed information on recreation resources, forest management guidance, and impact analysis is included in the Recreation Specialist Report available in the project record.

The Ashley LRMP Management areas allow dispersed recreation as an additional allowable use, including road and trail uses where they do not interfere with range and livestock management (MA d) wildlife management (MA e), or multiple output uses (MA n).

3.12.1.1 Recreation Opportunity Spectrum

The Recreation Opportunity Spectrum, or ROS, provides a range of opportunity classes based on the physical, managerial, and social settings of the area. As an inventory (map), it can guide management decisions, or be used to compare effects of management actions. ROS was not incorporated as a management prescription in the current LRMP (Paulin 2008). The most recent ROS inventory on the Ashley was completed in 2008. ROS classes found in the South Unit project area are *Roaded Natural 32%, Semi-primitive Motorized 53%, Semi-primitive Non-motorized 15%* (See Figure 1 in the Recreation Specialist Report). *Roaded Natural* settings (class) have some developments, including low to high standard roads. *Semi-primitive Motorized* settings have very few facilities; most include only low standard roads and trails. Motorized travel is allowed on designated routes in areas with these ROS classes. *Semi-primitive nonmotorized* settings have very few developments, and included routes are not designated for motorized travel. Recreational opportunities in these classes fit within these settings. There are no developed campgrounds or trailheads in the area.

3.12.1.2 Recreational Visitors and Activities

Hunting and associated dispersed camping and ORV use are the most common recreational activities in the area. Elk hunters (muzzle, archery, and rifle seasons) and deer hunters (muzzle and rifle seasons) account for 870 and 200 user days per year, respectively (Bartel 2008). The Project Area is located within the Nine Mile/Anthro elk unit that is managed as a limited-entry hunting unit. Opportunities to hunt elk within this unit are highly prized by the public. Hiking and trail-based recreation is limited within the Project Area to two short sections of trails (approximately 2.2 miles). Some winter use, such as snowmobiling and cross-country skiing, occurs in the higher elevations (Paulin 2008).

ORV use is limited to designated routes and trails within the Project Area. Motorized cross-country travel is prohibited (Forest Service 2007m). Currently, the Project Area offers 36.2 miles of ORV trails. ORV use is often associated with other activities such as hunting, camping, and antler collecting. Access to commercial outfitters is permitted within the Project Area for big game hunting and wilderness therapy programs. Hunting outfitters use the Project Area in the fall during hunting season. Wilderness therapy outfitters use the area for adolescent therapy programs to provide a remote, wilderness experience. Small groups of students and instructors travel on trails and cross country for an average stay of six to eight weeks throughout the year. Access roads are used occasionally to provide supplies and services to the groups while they are in the Project Area.

In 2007, wilderness therapeutic groups accounted for 2,800 Service Days annually and that number is anticipated to remain constant through 2015.

3.12.2 Environmental Consequences

None of the alternatives are expected to deviate from LRMP direction for recreation. Concerns from the alternatives include the potential change loss of visitor opportunities in undeveloped backcountry, and is expressed as a change from Semi-primitive ROS classes to Roaded Natural or its sub-class of Roaded Modified. All of the action alternative would result in some of this change, but at different rates, intensity, and distribution. Indirect recreation impacts are related to the resources upon which each activity depends, (i.e., hunting, wildlife watching, and wildlife photography would be affected by impacts to wildlife). Impacts upon wildlife, transportation, and other resources are discussed in their respective sections. Generally, impacts to recreation would occur throughout the LOP within each alternative, and impacts would vary in intensity depending primarily on the level of activity, level of surface disturbance, extent of road network, and the success of reclamation efforts. However, recreation activities represent a small fraction of activities within the Project Area, and impacts would be proportional to the low level of use in the area.

3.12.2.1 Impacts Common to All Alternatives

Recreation visitors, particularly lifestyle (repeat) visitors will be affected by the changes to the recreation setting in all the action alternatives. Improvements to system roads will make accessing the area easier. Additional disturbed areas, noise and dust may displace some visitors to other public lands, particularly if they are looking for remoteness or solitude. Outfitting in the area may become more difficult for the same reasons and resulting client satisfaction. Hunters may have a lower chance of success, particularly in areas where developments are in process and commercial vehicle traffic is present.

Motorized travel would remain confined to existing designated routes; however, it may be difficult to enforce travel restrictions on new routes created by the development. An increase in illegal off-road travel is probable under action alternatives.

3.12.2.2 Alternative 1 – No Action Alternative

Dispersed Recreation: No additional impacts to recreation would occur under this alternative due to oil and gas development beyond current levels and trends of activities. This alternative presents the least direct and indirect impacts to dispersed recreation by maintaining the primarily undeveloped character of the area.

Commercial Outfitters: Under the No Action Alternative, the current resource environment would continue for commercial outfitters. No impacts would be anticipated from direct or indirect affects.

3.12.2.3 Alternative 2 – Proposed Action

Dispersed Recreation: Direct and indirect impacts would be anticipated as a result of the development under this alternative. As 15 miles of new roads would be constructed within areas currently inventoried under ROS as Semi-primitive Non-motorized classes. Opportunities for solitude, remoteness, and backcountry travel would be reduced and users seeking this type of experience would be displaced. BMPs that limit the number of well pads and specify winter range stipulations under this alternative would reduce some of the impacts to wildlife, and therefore indirectly reduce impacts to wildlife-based recreation.

Commercial Outfitters: Impacts to commercial outfitters under this alternative would be related to the loss of unroaded areas, habitat fragmentation, and increased human activity. Winter stipulations would reduce some of the impacts to wildlife and therefore to hunting outfitters.

3.12.2.4 Alternative 3

Dispersed Recreation: Dispersed recreation resources related to solitude, wildlife, specific habitats, and sensitive resources would receive less impacts under Alternative 3 than the Proposed Action due to the emphasis on phased drilling, mitigation for big game, and separate POD considerations for crucial deer winter and summer range areas. Several aspects of this alternative, such as clustering facilities and concentrating the infrastructure in central locations, would reduce the amount of landscape fragmentation at any one time during the LOP. While the new roads in currently unroaded areas would eventually downgrade the Semi-primitive Non-motorized area, that level of development would occur gradually across the LOP. Therefore, this alternative would contain the impacts to recreation to specific corridors during a phased development strategy, and therefore allow for some solitude, a sense of remoteness in undisturbed areas, and less wildlife habitat fragmentation.

Commercial Outfitters: The phased development of this alternative would allow for commercial outfitters to continue using the unroaded portions of the Project Area without development for a certain period of time, and therefore would potentially postpone the eventual loss of remote character to the end of the LOP. BMPs that would limit well pad locations and sizes, reduce visual impacts, and protect wildlife and raptors would reduce the impacts to wildlife and visual resources, and therefore reduce indirect impacts to outfitters through minimizing these disturbances. As with the other alternatives, the eventual loss of remoteness and fragmentation of wildlife habitat would impact these users.

3.12.2.5 Alternative 4

Dispersed Recreation: Impacts to recreation through actual surface disturbance would be lower under Alternative 4 than the Proposed Action due to the limitations placed upon new well pad development and the reduction in the number of well pads. However, the development pattern would be more evenly distributed throughout the Project Area for the LOP rather than concentrated or phased as in Alternative 3; no particular area would be left undisturbed for a sense of remote recreation.

Commercial Outfitters: Impacts to commercial outfitters would be similar to the Proposed Action under this alternative.

3.12.3 Cumulative Impacts

Very little recreational use is currently documented within the Project Area, and therefore sources of information regarding changes in use are limited. However, recreational use has increased throughout the ANF in general over the last 20 years, and some level of increased use would be anticipated in the Project Area. Impacts to overall use would not be significant; however certain elements of the resource would change due to the increase in development where there currently is none such as Semi-primitive Non-motorized areas. Increases in oil and gas development would cause a loss of solitude and remoteness; increase in noise, traffic, and human presence; and increase in wildlife habitat

fragmentation from the construction of roads. The ROS Semi-primitive Non-motorized class would be greatly reduced if not eliminated from the Project Area as development in the area increased. Forest visitors seeking these resources and associated experiences would be displaced to some degree under all alternatives except the No Action Alternative.

3.13 Potential Wilderness & Inventoried Roadless Areas

3.13.1 Affected Environment

3.13.1.1 Introduction

The process used to identify and evaluate National Forest System lands for wilderness suitability began as directed in the Wilderness Act of 1964. Roadless Area Review and Evaluation, or RARE, was initiated in 1971 and the FEIS was published in 1973 (Forest Service 1979). In 1977 RARE II was initiated in response to concerns about areas overlooked in RARE I. The RARE II process was conducted using new definitions of roadless attributes. However, the RARE II FEIS was challenged in court and found to be inadequate. The Forest Service responded with regulations requiring roadless evaluation during Forest Planning.

In September 1983, revised regulations for the National Forest Management Act of 1976 (CFR 36, Part 219.17) went into effect. A roadless area inventory and an evaluation for wilderness suitability were among the new forest planning requirements. Areas found suitable could be managed as prescribed by forest plans, and would be recommended to Congress for wilderness designation.

A Forest Plan for the ANF was initiated in 1982. The required roadless inventory and wilderness suitability study began in 1983, and 715,405 acres in 13 roadless areas were identified. The 1984 Utah Wilderness Act reduced the acreage of roadless areas by 273,426 acres through designation of the High Uintas Wilderness Area. The act prohibited further state-wide roadless reviews, however it did not remove inventory and evaluation requirements for subsequent forest plan revisions. No further consideration for roadless or wilderness proposals was made in the final 1986 Forest Plan for the ANF (Forest Service 1986). The plan was produced without including roadless area information, due to language in the Utah Wilderness Act. In 2000, the Forest Service, using current inventory criteria, produced a draft map of roadless area inventory in anticipation of Forest Plan Revision.

In 2001, the Forest Service promulgated a Roadless Area Conservation Rule (Roadless Rule) that provided certain protections for IRAs. That rule has been the subject of a number of conflicting court decisions. Currently, the Wyoming District Court has enjoined the Roadless Rule nationwide while a 9th Circuit Court ruling has reinstated the same Rule nationwide. This makes management in IRAs difficult, since compliance with one ruling will conflict with the other.

These conflicting rulings have not yet been fully resolved. Although the 10th Circuit Court of Appeals recently reversed the Wyoming District Court and upheld the Roadless Rule (Wyoming v. USDA, October 21, 2011), the injunction against the Roadless Rule remains in place until it has been lifted by the District Court of Wyoming. Timing will depend on whether the parties to the case seek further review by the 10th Circuit or the Supreme Court.

At this time the decision making authority for projects involving construction and reconstruction of roads and the cutting, sale, or removal of timber in inventoried roadless areas is reserved to the Secretary of Agriculture (Secretary‘s Memorandum 1042-156). This authority has been re-delegated to the appropriate Forest Service official in certain cases, namely activities involving wildfire suppression, search and rescue operations, and imminent threats to public health and safety. Approval of timber cutting, sale or removal incidental to implementation of existing special use authorizations, and cutting, sale, or removal of generally small diameter timber is also re-delegated when the purpose is to improve threatened, endangered or sensitive species habitat, maintain or restore ecosystem function, or provide wood products for administrative or personal use.

The road construction and reconstruction proposed within IRAs in the South Unit Project Area does not fall into any of the categories listed above, and must therefore be reviewed by the Secretary. This review process will ensure that actions in IRAs are carefully considered, and comply with any applicable laws. No decision will be made until the Secretary‘s review is complete and the Secretary approves, disapproves, or chooses to re-delegate authority for approval of the road construction and reconstruction within IRAs in the Project Area (Forest Service 2011).

Effects to IRAs for this analysis are based on NEPA requirements (36 CFR 220.5(a)(2)) to consider effects to the undeveloped character of these areas, and on scoping comments regarding effects to inventoried roadless and potential wilderness areas.

In 2004, Forest Service Region 4 adopted a new protocol for mapping areas to study for wilderness suitability during forest planning (Forest Service 2004c). Forest Service Handbook 1909.12, Chapter 70, was amended on January 31, 2007, with updated handbook direction consistent with the Region 4 mapping protocol for undeveloped areas. The handbook directs National Forests to use the term potential wilderness in place of roadless or undeveloped in new inventories, evaluations, and reports.

The 2004 Region 4 mapping protocol was used to complete the ANF draft potential wilderness (undeveloped) area inventory in 2005. Earlier roadless inventories were not used to identify potential wilderness areas. The draft 2008 evaluation report was last revised in 2009 (Forest Service 2009b). NEPA direction includes analysis and disclosure of effects to undeveloped character for these potential wilderness areas during forest planning, but this step has not been completed.

National Direction is included in 36 CFR Part 220 – NEPA Compliance. One of the factors for determining the level of NEPA needed is the presence of IRAs or potential wilderness in or near the Project Area, and the potential for proposals to alter the undeveloped character of an IRA or a potential wilderness area. Methods of analysis are not specified; however, tools for evaluating wilderness are available in the wilderness attribute rating system developed for RARE II. Factors used in evaluating the wilderness capability and quality of wilderness potential are found in Forest Service Handbook 1909.12, Chapter 70.

Regional Guidance is provided in Suggestions for Analyzing the Effects to Wilderness Potential from Project Activities within IRAs (Welsh 2008). The document includes suggestions for describing and analyzing effects to roadless characteristics and wilderness potential. This document describes a cross-walk between the wilderness capability quality factors and wilderness attributes.

Forest Plan Direction is not provided for ANF roadless lands or other lands with wilderness potential. Roadless inventories were originally a part of forest planning, and a part of the process for determining what lands might be proposed for wilderness designation. The ANF Plan was completed in 1986, shortly after the Utah Wilderness Bill was passed in Congress (Forest Service 1986). Information from the roadless inventory and evaluation was not included in the 1986 ANF Plan, and the existing inventory of potential wilderness areas is not included in the plan because it was completed at a later date.

During the NEPA process, several options were considered for this analysis. The initial approach was to analyze effects to roadless characteristics, as defined by the Roadless Rule for IRAs, and wilderness attributes would be analyzed for lands in the 2005 Potential Wilderness Inventory. The series of court rulings described earlier enjoined the Forest Service from applying the 2001 Roadless Rule in the ANF. The effects of the alternatives on wilderness potential and roadless characteristics are included to address public comment and concern for these resources, and to provide for an informed decision.

3.13.2 Potential Wilderness Areas

An inventory of ANF lands with wilderness potential was completed in 2005 using the Forest Service protocol developed for Forest Service Region 4 in 2004. The 2005 Potential Wilderness Inventory best represents lands in the ANF with potential for wilderness designation, because it is the most recent inventory, and is based on current data that takes into account the effects of existing designated roads, disturbance, and other uses not consistent with wilderness attributes. The inventory includes 677,868 acres in 37 Potential Wilderness Areas; 13,712 acres in four Potential Wilderness Areas fall within the Project Area (Table 3-57). These Potential Wilderness Areas are Cottonwood, Sowers Canyon East, Nutters Canyon, and Alkali Canyon. A description of the areas and evaluation of their wilderness qualities are included in the 2008 inventory and evaluation report available on the ANF website (Forest Service 2008a). The report will be updated and completed when Forest Plan revision work resumes. The report was used as base information for describing wilderness attribute conditions. Wilderness attributes of untrammeled, apparent naturalness, undeveloped character, opportunities for solitude and primitive recreation, special features, and manageability have been identified as standard for determining effects to wilderness potential in project NEPA (Welsh 2008).

3.13.2.1 Analysis Methods

A method for recording likely effects to wilderness potential is clearly laid out in a 2008 papers, Suggestions for analyzing the effects to wilderness potential from project activities within Inventoried Roadless Areas and Worksheet for Evaluating the Effects of Project Activities on Wilderness Attributes, compiled by Randy Welsh of Region 4, Forest Service. The method and worksheets describe each wilderness attribute as follows:

1. **Untrammeled:** This quality monitors modern human activities that directly control or manipulate the components or processes of ecological systems inside wilderness. In summary, *wilderness is essentially unhindered and free from modern human control or manipulation.*

   The untrammeled attribute is a measure of whether the long-term ecological **processes** of the area are intact and operating. It describes the extent to which human influences have altered natural processes away from what one would expect without those

impacts. Address this attribute by describing the impact your project activities may have on natural processes in the area and by describing any effects these changes may cause within the area.

2. **Natural:** This quality monitors both intended and unintended effects of modern people on ecological systems inside wilderness since the time the area was designated. In summary, *wilderness ecological systems are substantially free from the effects of modern civilization.*

   Naturalness is a measure of past and proposed activities on the appearance of naturalness of the area to the casual observer. This is a measure of the degree of environmental modification that will occur because of your project. Address this attribute by describing the extent of modification that will occur in the Roadless area,(i.e. length of roads built, facilities constructed) and how apparent the impact will be to the visitors of the area in both the short-term and the long-term. Effects should be judged from a layman‘s point of view. Consider existing scenic integrity and ROS layers.

3. **Undeveloped:** This quality monitors the presence of structures, construction, habitations, and other evidence of modern human presence or occupation. In summary, w*ilderness is essentially without permanent improvements or modern human occupation.*

   Undeveloped is a measure of the presence of the sights and sounds of civilization. It tries to indicate whether the visitor will experience a setting that is removed from civilization. Address this attribute by describing any sights or sounds of civilization that will occur during the projects duration or resulting after the project is finished. Also address any change in how a visitor might access the area. Consider using ROS maps layers.

4. **Outstanding opportunities for solitude or a primitive and unconfined type of recreation:** This quality monitors conditions that affect the opportunity for people to experience solitude or primitive, unconfined recreation in a wilderness setting, rather than monitoring visitor experiences *per se*. In summary, *wilderness provides outstanding opportunities for people to experience solitude or primitive and unconfined recreation, including the values of inspiration and physical and mental challenge.*

   Solitude is described as opportunities to experience solitude, or the isolation from the sights, sounds, and presence of others and from the developments and evidence of man. Solitude is measured by looking at the size of the area, the presence of screening, distance from impacts to the rest of the area, and degree of permanent intrusions. Address solitude by discussing how the project activities affect the ability of a visitor to escape project impacts on solitude within the area. Consider linking to ROS mapping for size and remoteness criteria for Primitive and SPMN.

   Opportunities for Primitive Recreation is a measure of the experiences available to be isolated from the evidence of man, to feel a part of nature, to have a vastness of scale, and a high degree of challenge and risk while using outdoor skills. Address this attribute by describing how the project activities might affect the size of the area, the number and type of opportunities available, the challenge of the opportunities, and the addition or absence of facilities.

5. **Special Features (Ecological, Geologic, Scenic or Historical):** An attribute that recognizes that wilderness may contain other values of ecological, geologic, scenic or historical or cultural significance. Unique fish and wildlife species, unique plants or plant communities, potential or existing research natural areas, outstanding landscape features, and significant cultural resource sites should all be considered as types of values that might exist. Identify any of these values that exist within the project area. Address this attribute by describing the effect proposed activities would have on these values. Consider Scenic Attractiveness link.
6. **Manageability (as Wilderness):** A measure of the ability to manage an area to meet the size criteria (5,000 + acres), the resulting configuration of the potential wilderness, and the interaction of the other elements above. Changes in the shape of the Inventoried Roadless Area may have significant consequences to its wilderness potential. Consider also boundary management impacts such as changing wilderness boundaries to different terrain features or for how access would be provided if project activities cause adjustments in the Inventoried Roadless Area. Address this attribute by discussing how the proposed activities may affect the boundary location, the size, the shape, and the access to the area. Consider ROS mapping.

Worksheets were not completed due to the number that would be needed for each and each potential wilderness area; and the similar nature of effects across the project area. The definitions and general method were used instead. GIS was used also used to compare the alternative development scenarios by alternative and to calculate acres of expected disturbance by alternative.

Proposed Activities

Per well disturbance estimates at 40-acre well density are based on a 2.5-acre well pad. At the beginning of pad construction, surface soils would be salvaged and stockpiled adjacent to the well pad site for future use in site reclamation. However, disturbance within the areas is virtually equal to the overlap of the project area with the Potential Wilderness Areas, due to the lack of integrity in the remaining landscape caused by fragmenting nearly intact natural systems.

3.13.3 Affected Environment

3.13.3.1 Cottonwood Potential Wilderness Area

Physical and Biological Description:

Elevations range from 6,000 feet in the north to 9,354 feet at the summit of Left Fork Indian Canyon. The topography includes several main drainages with numerous side slope drainages all of moderate of steep slopes. Above are gently rounded hilltops and plateau areas. The western half of the area (Left Fork Indian Canyon drainages) has mixed conifers dominated by Douglas-fir with occasional aspen stands in the higher elevations. Mid-elevations have stands of dense Douglas-fir with aspen on northern aspects, and sparse pinyon pine with Douglas-fir on southern aspects. Grasses, sagebrush, and mountain mahogany cover less steep slopes. In the eastern half of the area (Sowers Canyon drainages), the species mixes are the same, but grass and sagebrush areas are more open with dense north facing Douglas-fir stands. Fire occurrence is moderate throughout the area.

A variety of wildlife species frequent and inhabit the area. Some of the area has been designated by Utah Division of Wildlife Resources as high value winter range for deer and elk, and summer habitat for pronghorn. The area also provides corridors for migration of large mammals between adjacent National Forests.

Existing Activities:

Livestock grazing and recreational hunting are the most common uses. Wildlife habitat improvement projects are planned for the area. Oil and gas leases cover most of the area; there are three oil and gas wells present in the area.

Description of Wilderness Attributes:

1. Untrammeled – The area is generally untrammeled; natural processes have been altered in small disturbed areas around existing roads. Livestock grazing, management for large herds of deer and elk, and fire suppression have slightly changed grass and shrub vegetation from pre-settlement conditions.
2. Natural – The area is mostly natural appearing with a few small areas of disturbance from livestock water developments and gas wells, but is influenced by its narrowness and position above roads below.
3. Undeveloped – The undeveloped character is mostly intact, with ROS mapped as 34 percent semi-primitive non-motorized and 17 percent semi-primitive motorized classes. About half (49 percent) is roaded natural class, with influence of roads and associated activities. Use on roads is minor; but noise, existing oil and gas developments, minor grazing developments, and road corridors into the area do affect the undeveloped character.
4. Opportunities for solitude and primitive or unconfined recreation – The opportunities are excellent in some parts of the area due to the limited recreation pressure, the screening effects and challenge of the terrain in the canyon areas where there is no motorized use. There are influences from motorized activities along the boundary and excluded roads which detract from the overall opportunities.
5. Special Features: No special features have been identified in the area.

6. Manageability (as Wilderness): The area would be difficult to manage as wilderness. Boundaries on all but the north follow road corridors and have penetrating excluded road corridors off of them, where exploratory gas wells, power lines, wildlife projects, and recreation activities are common.

Project Area and Cottonwood Potential Wilderness:

The total acreage of the Potential Wilderness Area is 25,989 acres, with 2,095 acres (8.1%) overlaying the Project Area. The Cottonwood Potential Wilderness Area covers the northwestern-most corner of the Project Area and extends through the central portion of the South Unit of the ANF. This Potential Wilderness Area is bordered to the west by U.S. Highway 191 (Indian Canyon Scenic Byway) and by FSR 152 (Sowers Canyon) to the east. A few excluded road corridors extend into the area.

Physical and Biological Description:

Elevations range from 6,000 feet in the north to 9,300 feet in the south. North and South Twin Hollow areas have steep, long canyon side slopes. North aspects have dense stands of Douglas-fir and aspen. Southern aspects support sparse pinyon pine and Douglas-fir. Gentler slopes and plateaus are covered by grasses, sagebrush, and mountain mahogany.

Drainages to Sowers Canyon are covered with sparse pinyon pine, Douglas-fir, and juniper communities on south-to-west aspects. North-to-east aspects are covered with dense pinyon pine and Douglas-fir or a mix of grasses, sagebrush, and mountain mahogany. Along the lower end of Sowers Canyon the terrain is dissected into ridges off the sides of plateaus covered by moderately dense pinyon pine and juniper. Areas of perennial grass and mountain mahogany are intermixed with the pinyon pine and Douglas-fir. Fire occurrence is moderate across the area.

A variety of wildlife species frequent and inhabit the area. Some of the area has been designated by Utah Division of Wildlife Resources as high value winter range for deer and elk, and summer habitat for pronghorn. The area also provides corridors for migration of large mammals between adjacent National Forests.

Existing Activities:

Livestock grazing and recreational hunting are the most common uses. Wildlife habitat improvement projects are planned for the area. Oil and gas leases cover most of the area, and there are two wells present.

Description of Wilderness Attributes:

1. Untrammeled – The area is generally untrammeled; natural processes have been altered in small disturbed areas around existing roads. Livestock grazing, management for large herds of deer and elk, and fire suppression have changed grass and shrub vegetation from pre-settlement conditions.
2. Natural – The area is mostly natural appearing with a few small areas of disturbance from livestock water developments and gas wells, but is influenced by its narrowness and position above roads below.
3. Undeveloped – The undeveloped character is mostly intact, with areas of exception. The area is mapped as 4,006 acres (22 percent) semi-primitive non-motorized, 9,573 acres (57 percent) semi-primitive motorized, and 3,449 acres (21 percent) roaded

natural ROS classes. The area has existing effects from fences, water developments for grazing, gas wells; and sights, sounds, and smells of motorized activities on nearby roads and trails.

4. Opportunities for solitude and primitive or unconfined recreation – The opportunities are good due to the limited recreation pressure, non-motorized Trail 101 in Clem Hollow, the screening effects of terrain, and the part of the area with little influence from motorized activities. There are influences from motorized activities along the boundary and excluded roads which detract from the overall opportunities.
5. Special Features: No special features have been identified in the area.
6. Manageability (as Wilderness): The area would be difficult to manage as wilderness. Boundaries on all but the north follow road corridors and have penetrating excluded road corridors off of them, where exploratory gas wells, power lines, wildlife projects, and motorized recreation activities are common.

Project Area and Sowers Canyon East Potential Wilderness:

The total acreage of the Potential Wilderness Area is 17028 acres, with 3,886 acres (22.8%) overlaying the Project Area. The Sowers Canyon East Potential Wilderness Area extends through the central portion of the South Unit of the ANF and the western half of the Project Area. This area is bordered by FSR 152 (Sowers Canyon) along its western edge, by FSR 332 (Wire Fence Ridge) along its southeastern edge, and by Wire Fence Canyon on its eastern edge. A few excluded road corridors extend into the area. Elevations range from 6,000 feet in the north to 9,300 feet in the south.

3.13.3.2 Nutters Canyon Potential Wilderness Area, 5,320 acres

Physical and Biological Descriptions:

Elevations range from 6,800 feet to 8,700 feet. The area includes hilly terrain and dissected side slopes between the adjacent plateaus. Vegetative cover consists of sparse grass and sagebrush and/or pinyon pine, juniper and some Douglas-fir with bare soil in the south. The density of vegetation increases in the north, and includes areas of mountain mahogany. Fire occurrence is moderate.

A variety of wildlife species frequent and inhabit the area. Some of the area has been designated by Utah Division of Wildlife Resources as high value winter range for deer and elk, and summer habitat for pronghorn. The area also provides corridors for migration of large mammals between adjacent National Forests.

Existing Activities:

Livestock grazing and recreational hunting are the most common uses of the area. Oil and gas leases cover most of the area, there are wells, and additional oil and gas developments are proposed.

Description of Wilderness Attributes:

1. Untrammeled – The area is generally untrammeled; natural processes have been altered in small disturbed areas around existing roads. Livestock grazing, management for large herds of deer and elk, and fire suppression have slightly changed grass and shrub vegetation from pre-settlement conditions.

2. Natural – The area is mostly natural appearing with a few small areas of disturbance from livestock water developments and gas wells, but is influenced by its narrowness and position above roads below.
3. Undeveloped – The undeveloped character is mostly intact, but heavily influenced from the boundaries due to its narrow shape between roads. The area is mapped as 3,595 (68 percent) semi-primitive motorized, and 1,725 acres (32 percent) roaded natural ROS classes. The area has effects from fences, water developments for grazing, oil and gas developments; and sights, sounds, and smells of motorized activities on nearby roads and trails.
4. Opportunities for solitude and primitive or unconfined recreation – The opportunities are moderate due to the narrow width of the area between roads and activities on them, and the absence of challenging terrain.
5. Special Features: No special features have been identified in the area.
6. Manageability (as Wilderness): Manageability would be difficult. Much of the boundary can be located but may be difficult to enforce. Adjacent roads provide for visitor access but also add to potential conflict with other recreation uses and resource demands.

Project Area and Nutters Canyon Potential Wilderness:

The acreage of the Potential Wilderness Area is 5,320 acres with 3,262 acres (61.3%) overlaying the Project Area. The Nutters Canyon Potential Wilderness Area extends through the eastern flank of the South Unit of the ANF and Project Area. This Potential Wilderness Area is bordered by FSR 335 along Left Fork Antelope Ridge to the east and FSR 333 (Nutters Ridge) to the west. The acreage of the Potential Wilderness Area is 5,320 acres with 3,262 acres (61.3%) overlaying the Project Area.

3.13.3.3 Alkali Canyon Potential Wilderness Area

Physical and Biological Descriptions:

Elevations range from 6,000 feet in the north to 8,797 feet in the south. The terrain has broad plateaus with moderately steep dissected side slopes above the narrow valleys. Hills are rounded in the north. Pinyon pine, Douglas-fir, and juniper cover the northern part of the area and many of the canyon walls and drainages in the south. Across the tops of the southern plateaus the cover opens to sagebrush and grass with areas of mountain mahogany. Fire occurrence is moderate across the area.

A variety of wildlife species frequent and inhabit the area. Some of the area has been designated by Utah Division of Wildlife Resources as high value winter range for deer and elk, and summer habitat for pronghorn. The area also provides corridors for migration of large mammals between adjacent National Forests.

Existing Activities:

Livestock grazing and recreational hunting are the most common uses of the area. There is one oil and gas well present.

Description of Wilderness Attributes:

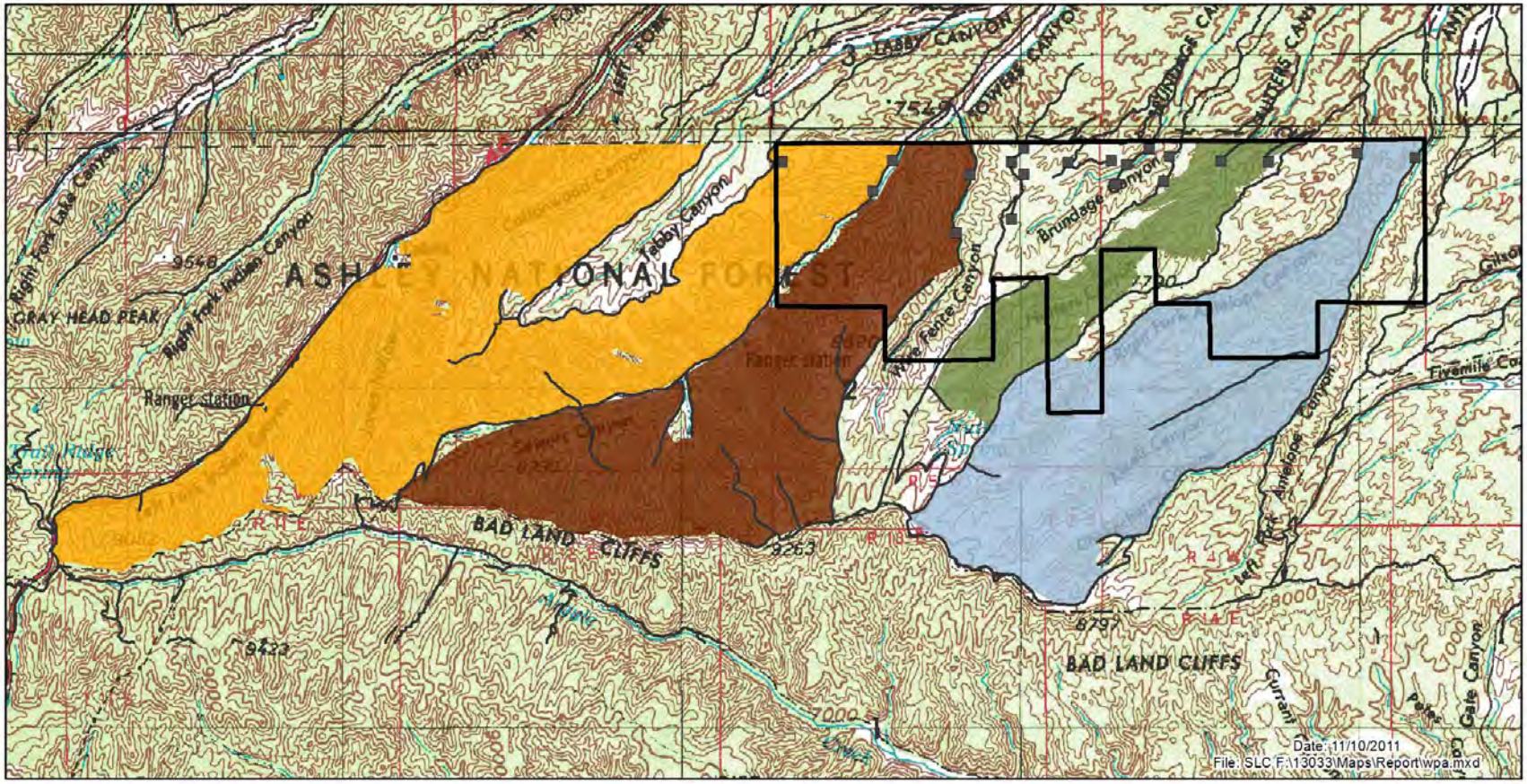
1. Untrammeled – The area is generally untrammeled; natural processes have been altered in small disturbed areas around existing roads. Livestock grazing, management

for large herds of deer and elk, and fire suppression have slightly changed grass and shrub vegetation from pre-settlement conditions.

2. Natural – The area is mostly natural appearing with a few small areas of disturbance from livestock water developments and gas wells, but is influenced by its narrowness and position above roads below.
3. Undeveloped – The undeveloped character is mostly intact, but heavily influenced from the boundaries due to its narrow shape between roads. The area is mapped as 3,595 (68 percent) semi-primitive motorized, and 1,725 acres (32 percent) roaded natural ROS classes. The area has effects from fences, water developments for grazing, oil and gas developments; and sights, sounds, and smells of motorized activities on nearby roads and trails.
4. Opportunities for solitude and primitive or unconfined recreation – Encounters with others are common in the area, especially along the boundaries and near excluded road corridors. There may be opportunities for solitude in the north-central part of the area, but the terrain and vegetation offer little to attract visitors.
5. Special Features: There are prehistoric sites in the area.
6. Manageability (as Wilderness): The area is about 4 miles across at its widest east-west span, and has only a few sections on the north which are more than a mile from a road due to the locations of roads in excluded corridors. Most of the boundary can be located but would be difficult to enforce.

Project Area and Alkali Canyon Potential Wilderness:

The acreage of the Potential Wilderness Area is 16,885 acres with 4,469 acres (26.5%) overlaying the Project Area. The Alkali Canyon Potential Wilderness Area extends through the eastern flank of the South Unit of the ANF and Project Area. This Potential Wilderness Area is bordered by FSR 154 along Left Fork Antelope Canyon to the east and FSR 191 (Right Fork Antelope Canyon) to the west. A few excluded road corridors extend into the area.



Project Area
Areas with Wilderness Potential
Alkali Canyon
Cottonwood
Nutters Canyon
Sowers Canyon East
Existing Well Pad within the Project Area
Existing Road

Miles 0 2 4
Kilometers 0 3 6

Scale: 1:200,000
Projection: UTM NAD83, Zone 12, Meters
Base Map: USGS 250k Topographic Map
Quadrangle: Salt Lake City, UT
and Price, UT
Township 5-6S/10S Range 3-6W/14-15E
Duchesne County, Utah

N

Figure 3-23. Areas with Wilderness Potential Overlapping the Project Area.

3.13.4 Environmental Consequences

General effects of disturbance from constructed well pads, structures, transportation systems, and use of roads

The disturbance density varies by alternative, and includes from one to six well pads per square mile and 1 to 5 miles of road per square mile. Each well pad and road bed would affect natural soil, vegetation, and other physical and biological features not only on the part of the area disturbed, but also the surroundings, depending on resource. For instance, the disturbance would not only be visible throughout the area, but also from some views outside the area, though location could reduce the effects. This effect to the natural appearance is the same in any wildland application. In other cases, effects to resources, such as historic sites (special features), can be avoided with placement of the development or disturbance unless such features are ubiquitous. Effects to each wilderness attribute are discussed in the alternatives.

No Action Alternative

Current management plans would continue to guide the management of the Project Area. With no actions from the project, no activities would occur in Project Area part of the potential wilderness areas from this project. Existing oil and gas leases, grazing and livestock developments, roads along boundaries, power lines, and wildlife habitat improvement projects represent current conditions within the potential wilderness areas. Wilderness attributes would remain in the condition described in the affected environment, above; there would be no degradation or improvement to the condition of the potential wilderness areas, and no future inventories would change due to impacts from this project.

Proposed Action

The disturbance and construction components of this alternative would degrade wilderness attributes in all areas where the Project Area overlaps potential wilderness areas to the point that they would not be mapped as areas with wilderness potential in the next inventory. Due to the size of less than 5000 acres (mapping criteria), none of Nutters Canyon would be mapped in the next inventory. The degradation of wilderness attributes would be impacts to the following for acres overlapping each Potential Wilderness Area.

Table 3-57. Total Acreages of Each Potential Wilderness Area

Identification Number	Name	Acreage of Potential Wilderness Area	Acres in the Project Area	% within Project Area
401407	Cottonwood	25,989	2,095	8.1%
401408	Sowers Canyon East	17,028	3,886	22.8%
401409	Nutters Canyon	5,320	3,262	61.3%
401410	Alkali Canyon	16,885	4,469	26.5%

Impacts to wilderness attributes in the project area part of each potential wilderness area

1. Untrammeled – The areas would have enough disturbance to no longer be considered untrammeled. Grading of and development averaging 5 to 10 well pads and 1 to 2 miles of road per square mile would leave little intact natural ecosystem due to the intensity and distribution of disturbed vegetation and soils. It is unlikely that any rehabilitation efforts or mitigations would return the area to an untrammeled state in the foreseeable future.
2. Natural – The natural appearance of the area would change to highly developed and industrial from the majority of views within and to it, even with mitigations of natural colors and other design to meet line, form, texture, and color. Degradations to naturalness would result in not having this wilderness attribute in the area into the foreseeable future.
3. Undeveloped – The undeveloped character would also be lost due to the density of ground disturbing and constructed features. ROS classes within the project area would convert to roaded natural, as would ROS of all areas within ½ mile of new roads for the duration of their use.
4. Opportunities for solitude and primitive or unconfined recreation – encounters with others and with truck and other development and maintenance equipment would remove opportunities for solitude. The degradation of naturalness and undeveloped character would result in no areas left with these opportunities.
5. Special Features: Any historic or prehistoric features would be protected by mitigations.
6. Manageability (as Wilderness): The areas would be very difficult to manage as wilderness. Even after the project and reclamation, road-beds, non-native vegetation, illegal motorized use on roads, and other issues would persist.

Alternative 3

The density of well pads, structures, and additional roads would be less than in the Proposed Action. However, due to the fragmenting of the areas with wilderness attributes, the overall effects would be similar to the proposed action.

Alternative 4

The impacts would be similar to the Proposed Action and Alternative 3.

3.13.5 Cumulative Effects to lands with Wilderness potential

Under all action alternatives the project would result in a loss of about 15,700 acres of lands meeting the criteria for potential or suitability for Wilderness designation. This would be in addition to lands across the Ashley National Forest and even the rest of the Nation that would lose those attributes due to oil and gas or other resource extractive processes. Such losses are likely to be cumulative over time.

Table 3-58. Surface Disturbance in Potential Wilderness Areas by Alternative

Potential Wilderness Areas	Cottonwood	Sowers Canyon East	Nutters Canyon	Alkali Canyon
Total acreage in the PWA	25,989	17,028	5,320	16,885
Percentage of PWA in Project Area	8%	23%	61%	26%
No Action				
Proposed disturbance (Acres)	00.0	00.0	00.0	0.0
Proposed roads (Miles)	0.0	0.0	0.0	0.0
Acres with wilderness potential after No Action (Acres)	25,989	17,028	5,320	16,885
Proposed Action				
Proposed disturbance (Acres)	99.6	174.9	158.2	152.0
Proposed roads (Miles)	6.1	11.4	9.0	10.5
Acres with wilderness potential after Proposed Action (Acres)	23,961	13,790	2,905 (0)	14,655
Alternative 3				
Proposed disturbance (Acres)	96.0	169.1	157.4	153.8
Proposed roads (Miles)	6.0	11.0	9.0	10.6
Acres with wilderness potential after Alternative 3 (Acres)	23,967	13,803	2,905 (0)	14,653
Alternative 4				
Proposed disturbance (Acres)	54.8	125.5	84.8	122.8
Proposed roads (Miles)	4.0	10.0	6.5	9.9
Acres with wilderness potential after Alternative 4 (Acres)	23,961	13,787	2,902 (0)	14,649

3.13.6 Inventoried Roadless Areas

Inventoried roadless areas refer to Forest Service lands that are identified in accordance with the 2001 Roadless Area Conservation Final Rule (36 CFR Part 294). In 2001, the Forest Service promulgated a Roadless Area Conservation Rule (Roadless Rule) that provided certain protections for IRAs. That rule has been the subject of a number of conflicting court decisions. Currently, the Wyoming District Court has enjoined the Roadless Rule nationwide while a 9th Circuit Court ruling has reinstated the same Rule nationwide. This makes management in IRAs difficult, since compliance with one ruling will conflict with the other.

These conflicting rulings have not yet been fully resolved. Although the 10th Circuit Court of Appeals recently reversed the Wyoming District Court and upheld the Roadless Rule (*Wyoming v. USDA*, October 21, 2011), the injunction against the Roadless Rule remains in place until it has been lifted by the District Court of Wyoming. Timing will depend on whether the parties to the case seek further review by the 10th Circuit or the Supreme Court, the State of Utah has approximately 4 million acres of IRAs. The ANF has approximately 795,990 acres of IRAs, with approximately 19,535 acres (2.5%) within the Project Area (Figure 3-24). The IRAs that overlap the proposed Project Area include Right Fork Antelope Canyon, Sowers Canyon, and Cottonwood. The total acreages of each IRA that overlaps the Project Area are shown in Table 3-58. Roadless characteristics for each IRAs within the Project Area are listed below.

Analysis Methods

A method for recording likely effects to roadless characteristics = is clearly laid out in a 2008 papers, *Suggestions for analyzing the effects to wilderness potential from project activities within Inventoried Roadless Areas* and *Worksheet for Evaluating the Effects of Project Activities on Roadless Effects*, compiled by Randy Welsh of Region 4, Forest Service. The method and worksheets describe each roadless characteristic as follows:

1. **Soil, water and Air resources -** Identify any unique or critical watershed resources. Describe how the project will affect these key resources areas and the habitats that depend on them.
2. **Sources of public drinking water -** Identify any public drinking water systems or sources within the project area or that would be affected by the project. Describe how the project would affect water quality and quantity of the public drinking water source.
3. **Diversity of plant and animal communities -** Discuss the diversity of plant and animal communities. Identify any unique plant and animal communities within the area. Describe effects to the diversity of communities and impacts to populations in the areas.
4. **Habitat for TES and species dependent on large undisturbed areas of land -** Identify any TES or sensitive species within the Roadless area. Describe how the project would affect the habitats or populations and whether this effect is significant across the normal range and distribution of these habitats and populations.
5. **Primitive and semi-primitive classes of recreation -** Describe current recreation opportunities within the Roadless area. Identify the effects of your project of the area and these activities. Describe the effect in terms of availability for similar experiences in surrounding areas or within the region of use. Consider link to ROS mapping.
6. **Reference landscapes for research study or interpretation -** Describe the landscape that is present. Describe any unique reference landscapes that exist within the Roadless area. Describe how the project activities might affect the reference landscape values of the Roadless area. Consider how the landscapes within the Inventoried Roadless area fits within the broader landscape and if the project creates any overall change. Consider landscape character descriptions in SMS.
7. **Landscape character and integrity -** Describe the current scenic quality and character of the area. Describe project effects to the scenic integrity of the area and changes to the character of the area. Consider existing scenic integrity.

8. **Traditional cultural properties and sacred sites -** Identify generically any significant cultural resources within the Roadless area and describe the effect of the project on these resources. Typically mitigation will be designed to prevent significant effects to these resources.
9. **Other locally unique characteristics -** Identify any locally unique characteristics and describe how the project would affect these values.

Proposed Activities

Per well disturbance estimates at 40-acre well density are based on a 2.5-acre well pad. At the beginning of pad construction, surface soils would be salvaged and stockpiled adjacent to the well pad site for future use in site reclamation. However, disturbance within the areas is virtually equal to the overlap of the project area with the roadless areas, due to the lack of integrity in the remaining landscape caused by fragmenting nearly intact natural systems.

3.13.7 Affected Environment

The three roadless areas include most of the lands within the potential wilderness areas, and additional lands that contain roads and other developments excluded from the potential wilderness areas, particularly either side of Nutters Canyon Potential Wilderness Area. The table below shows the acres of the roadless areas and how much of the project area falls within each area.

Table 3-59. Total Acreages of Each IRA Overlapping the Proposed Project Area.

Inventoried Roadless Area	Total Acreage of Inventoried Roadless Area	Acres in the Project Area	% within Project Area
Right Fork Antelope Canyon	30,378	11,154	37%
Sowers Canyon	21,886	6,298	29%
Cottonwood	30,134	2,083	7%

Elevations in these roadless areas range from 6,000 feet in the north to 9,700 feet in the south. The southwest to northeast oriented drainages are flanked by a mix of very steep rocky slopes and gentler sagebrush-grassland covered plateaus with stands of mountain mahogany. North aspects have dense stands of Douglas-fir and aspen interspersed with shrub-lands. Southern aspects support sparse pinyon pine and Douglas-fir or sagebrush-grasslands.

Some of the area has been designated by Utah Division of Wildlife Resources as high value winter range for deer and elk, and summer habitat for pronghorn. The area provides corridors for migration of large mammals between adjacent National Forests and lands under other administration. Smaller species are also present, but desert conditions limit summer occupation for many.

Livestock grazing and recreational hunting are the most common uses. Wildlife habitat improvement projects are planned for the area. Oil and gas leases cover most of the area, and there are many wells present and already approved.

Roadless Characteristics

1. Soil, water and Air resources - Water from the three IRAs contribute to instream flows of the Duchesne River and supply spring and pond water for livestock grazing within the area. More information on soil, water, and air resources within the Project Area can be found in the respective sections for each resource in the EIS.
2. Sources of public drinking water - No source of public drinking water has been identified in the area; however, water collected from the area above and below ground may be used for some domestic purposes.
3. Diversity of plant and animal communities – Pinion and juniper mixed forests, aspen stands, Douglas-fir with other species are present, as well as a mix of shrublands and grasslands. The area is identified as high value winter range for elk and mule deer, and connective corridors for large mammals are provided. The habitat is not particularly unique for Utah, but is mostly intact. More information is provided in the wildlife and vegetation sections of the EIS.
4. Habitat for TES and species dependent on large undisturbed areas of land – Habitat is not present within the project area for listed threatened or endangered species. Three sensitive plant species may be present in the area.
5. Primitive and semi-primitive classes of recreation – About 70 percent of the project area is inventoried as semi-primitive Recreation Opportunity Spectrum classes. Hunting is the most common activity, and often includes camping, OHV use or hiking. Outfitters also use the area. These activities are dependent on the undeveloped setting.
6. Reference landscapes for research study or interpretation - Some prehistoric sites and the historic Ute Indian horse corral site are present and available for interpretation or study. No other reference landscapes for research study or interpretation exist within the IRA
7. Landscape character and integrity - The characteristic landscape is currently mostly a natural appearing mountainous landscape with average variety in vegetation, and few water or other exceptional scenic features. Scenic integrity is generally high with small included oil and gas developments and grazing developments, mostly along public or administrative roads.
8. Traditional cultural properties and sacred sites - Some prehistoric sites and an historic Ute Indian horse corral site are present.
9. Other locally unique characteristics - No locally unique characteristics have been identified.

3.13.8 Environmental Consequences

General effects of disturbance from constructed well pads, structures, transportation systems, and use of roads

The disturbance density varies by alternative, and includes from one to six well pads per square mile and 1 to 5 miles of road per square mile. Each well pad and road bed would affect natural soil, vegetation, and other physical and biological features not only on the part of the area disturbed, but also the surroundings, depending on resource. For instance, the disturbance would not only be visible throughout the area, but also from some views

outside the area, though location could reduce the effects. This effect to the natural appearance is the same in any wildland application. In other cases, effects to resources, such as historic sites (special features), can be avoided with placement of the development or disturbance unless such features are ubiquitous. Effects to each wilderness attribute are discussed in the alternatives.

No Action Alternative

Current management plans would continue to guide the management of the Project Area. With no actions from the project, no activities would occur in Project Area part of the inventoried roadless areas from this project. Existing oil and gas leases, grazing and livestock developments, roads, power lines, and wildlife habitat improvement projects represent current conditions within the inventoried roadless areas. Roadless characteristics would remain in the condition described in the affected environment, above; there would be no degradation or improvement to the condition of the wilderness characteristics.

Table 3-60. Surface Disturbance in Inventoried Roadless Areas by Alternative.

Inventoried Roadless Areas	Right Fork Antelope Canyon	Sowers Canyon East	Cottonwood
Total acreage in the IRA	30,378	21,886	30,134
Percentage of IRA in Project Area	37%	29%	7%
No Action Alternative			
Existing number of well pads within the Project Area	4	2	3
Existing roads within the Project Area (Miles)	3.6	6.2	0.2
Proposed Action			
Proposed disturbance (Acres)	469	255	97
Proposed roads (Miles)	30.1	16.1	6.1
Alternative 3			
Proposed disturbance (Acres)	464	250	96
Proposed roads (Miles)	29.6	15.5	6.0
Alternative 4			
Proposed disturbance (Acres)	294	180	52
Proposed roads (Miles)	24.8	13.5	4.0

Proposed Action

The disturbance and construction components of this alternative would degrade most roadless characteristics in all areas where the Project Area overlaps inventoried roadless areas. The degradation of roadless characteristics would be impacts to most of the acres overlapping each inventoried roadless area.

Impacts to roadless characteristics in the project area part of each inventoried roadless area

1. Soil, water and Air resources – Water impacts are somewhat mitigated by BMPs used in project design and other mitigations. However, there may still be some increased sedimentation in the three IRAs and below in flows into the Duchesne River. Extensive impact information on soil, water, and air resources impacts within the Project Area can be found in the respective sections for each resource in the EIS.
2. Sources of public drinking water - No source of public drinking water have been identified in the area; however, water that could be used for domestic purposes may be affected.
3. Diversity of plant and animal communities – The ecological communities of the roadless areas will be altered by disturbance, construction, and resulting fragmentation to such a degree that their composition may change either temporarily or permanently.
4. Habitat for TES and species dependent on large undisturbed areas of land – The three sensitive plant species that may be present could be impacted. However, mitigations should be in place to relocate any developments that would impact them.
5. Primitive and semi-primitive classes of recreation – At the end of the development the approximate 70% of the area which is currently in semi-primitive ROS classes would be remapped as roaded natural, with a sub-class of Roaded Modified.
6. Reference landscapes for research study or interpretation – Existing historic and pre-historic sites should be protected by mitigations provided in the EIS and resulting development plan.
7. Landscape character and integrity - The characteristic landscape would change to an industrial landscape, with constructed features visually dominant over most of the area.
8. Traditional cultural properties and sacred sites - Some prehistoric sites and an historic Ute Indian horse corral site are present, and would be protected.
9. Other locally unique characteristics - No locally unique characteristics have been identified, and would therefore not be affected.

Alternatives 3 and 4

The density of well pads, structures, and additional roads would be less than in the Proposed Action. However, due to the fragmenting of the areas with roadless characteristics, the overall effects would be similar to the proposed action. For Alternative 4 the impacts would be similar to the Proposed Action and Alternative 3, but with less density.

3.13.9 Cumulative Effects to Inventoried Roadless Areas

Under all action alternatives the project would result in a loss of about 20,000 acres of inventoried roadless lands would not have roadless characteristics for the foreseeable future, even with rehabilitation. This would be in addition to lands across the Ashley National Forest and even the rest of the Nation that would lose those characteristics due to oil and gas or other resource extractive processes. Such losses are likely to be cumulative over time.

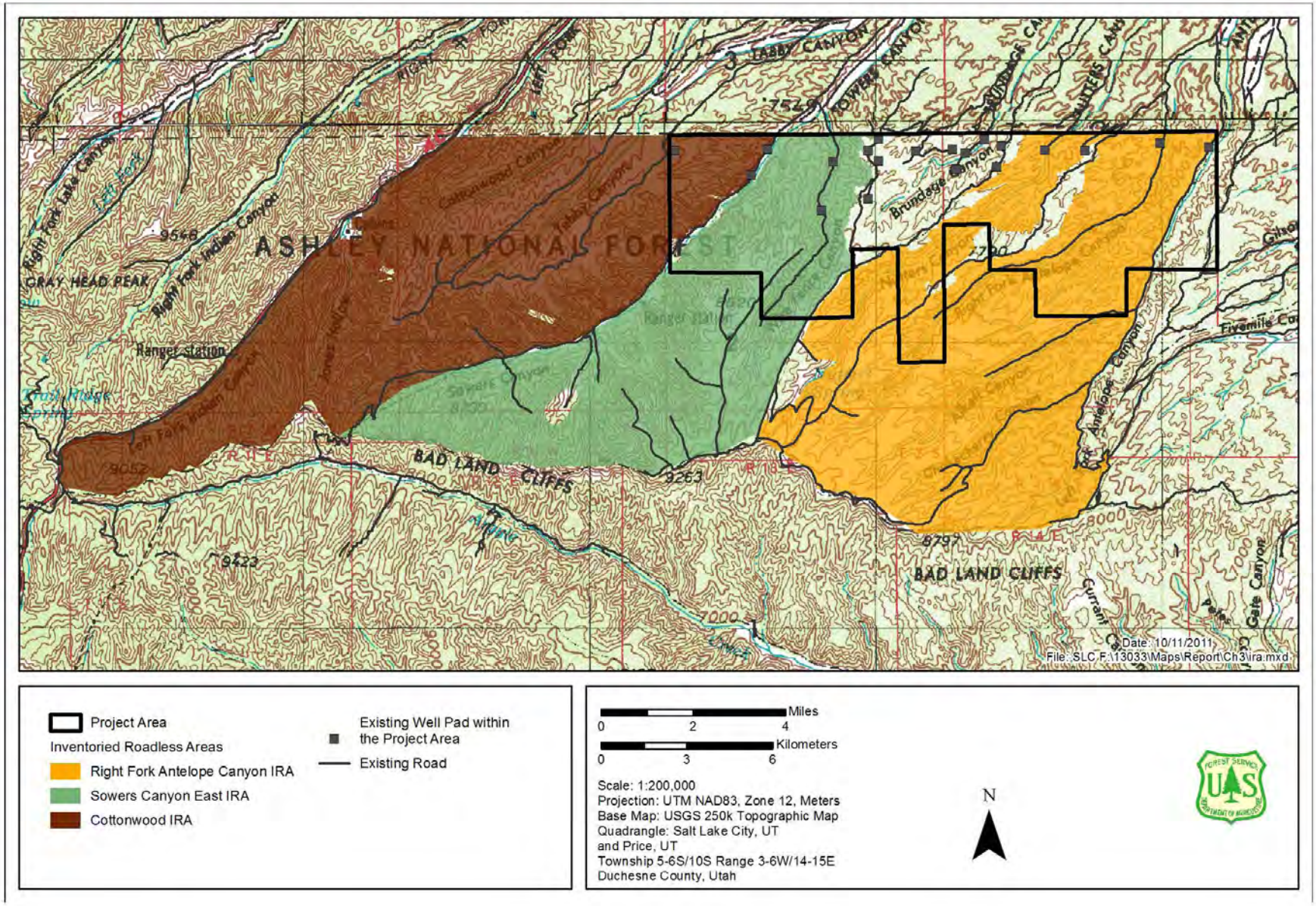


Figure 3-24. Inventoried Roadless Areas Overlapping the Project Area.

3.13.9.1 Right Fork Antelope Canyon IRA

1. Soil, water, and air resources – Soil within the IRA is typical for the Project Area. Detailed information on soil resources within the Project Area can be found in Section 3.5. The portion of the IRA in the Project Area is located within the Antelope Creek watershed. Left Fork Antelope Canyon, Right Fork Antelope Canyon, Nutters Canyon, and Brundage Canyon all cross through the IRA in the Project Area. All of these drainages are either intermittent or ephemeral. Water from the IRA contributes to instream flows of the Duchesne River and supplies spring and pond water for livestock grazing within the area. More information on water resources within the Project Area can be found in Section 3.6. Air quality is regional in nature, and detailed information on air quality can be found in Section 3.2.
2. Sources of public drinking water – No public drinking water sources have been identified within the Project Area.
3. Diversity of plant and animal communities – The majority of the IRA consists of pinyon-juniper woodland. A few shrub communities exist in scattered locations within and adjacent to the IRA in the Project Area. A small amount of aspen exists within the southwestern most portion of the IRA in the Project Area. Much of the IRA is used for livestock grazing. Some of the IRA has been designated by Utah Division of Wildlife Resources as high value winter range for deer and elk and summer habitat for pronghorn. Detailed information regarding plant and animal communities within the Project Area can be found in Sections 3.8. and 3.9, respectively.
4. Habitat for threatened, endangered, or sensitive species and species dependent on large undisturbed areas of land – No threatened or endangered species are expected to occur in the IRA due to lack of suitable habitat. Suitable habitat for sage-grouse, a candidate species, overlaps a portion of the IRA within the Project Area (see Figure 3-17) Information regarding Forest Service sensitive species and MIS in the Project Area can be found in Sections 3.9.1.2 and 3.9.1.3, respectively.
5. Primitive and semi-primitive classes of recreation – Right Fork Antelope Canyon IRA contains 1,359 acres of semi-primitive non-motorized and 6,495 acres of semi-primitive motorized recreation classes.
6. Reference landscapes for research study or interpretation – Some prehistoric sites and the historic Ute Indian horse corral site are present, which may require motorized access or structures for interpretation and protection. No other reference landscapes for research study or interpretation exist within the IRA.
7. Landscape character and integrity – Natural systems within the IRA currently have moderate effects from livestock grazing, water uses, and vegetative treatments. Currently, the visual and scenic integrity in the area allows for a classification that permits activities to have visual impacts or contrasts that dominate the existing landscape characteristics, but must borrow from the naturally established line, form, color, and texture within the landscape.
8. Traditional cultural properties and sacred sites – TCPs may exist within the IRA in the Project Area and some prehistoric sites and the historic Ute Indian horse corral are present.

9. Other locally unique characteristics – No other locally unique characteristics are identified for this IRA.

3.13.9.2 Sowers Canyon East IRA

1. Soil, water, and air resources – Soil within the IRA is typical for the Project Area. Detailed information on soil resources within the Project Area can be found in Section 3.5. The portion of the IRA within the Project Area is located within the Antelope Creek watershed. Wire Fence Canyon crosses through the IRA in the Project Area, while Sowers Canyon forms the western boundary of the IRA. Wire Fence Canyon contains an intermittent stream. Sowers Creek in Sowers Canyon represents the only perennial stream in the Project Area. Water from the IRA contributes to instream flows of the Duchesne River and supplies spring and pond water for livestock grazing within the area. More information on water resources within the Project Area can be found in Section 3.6. Air quality is regional in nature, and detailed information on air quality can be found in Section 3.2.
2. Sources of public drinking water – No public drinking water sources have been identified within the Project Area.
3. Diversity of plant and animal communities – The majority of the IRA in the Project Area consists of pinyon-juniper woodland; however, a few areas of coniferous forest and shrubland habitats exist in the southern portion of the IRA within the Project Area. A few shrub communities exist within and adjacent to the IRA in the Project Area. Much of the IRA is used for livestock grazing. Some of the IRA has been designated by Utah Division of Wildlife Resources as high value winter range for deer and elk and summer habitat for pronghorn. Detailed information regarding plant and animal communities within the Project Area can be found in Sections 3.8, and 3.9, respectively.
4. Habitat for threatened, endangered, or sensitive species and species dependent on large undisturbed areas of land – No threatened or endangered species are expected to occur in the IRA due to lack of suitable habitat. Suitable habitat for sage-grouse, a candidate species, overlaps a portion of the IRA within the Project Area (see Figure 3-17). Information regarding Forest Service sensitive species and MIS in the Project Area can be found in Sections 3.9.1.2 and 3.9.1.5, respectively.
5. Primitive and semi-primitive classes of recreation –Sowers Canyon East IRA contains 1,610 acres of semi-primitive non-motorized and 2,989 acres of semi-primitive motorized recreation classes.
6. Reference landscapes for research study or interpretation – One Research Natural Area exists approximately 4 miles south of the Project Area within the IRA. No other reference landscapes for research study or interpretation exist within the IRA.
7. Landscape character and integrity – Natural systems within the IRA currently have moderate effects from livestock grazing, water uses, and vegetative treatments.
8. Traditional cultural properties and sacred sites – TCPs may exist within the IRA in the Project Area.
9. Other locally unique characteristics – No other locally unique characteristics are identified for this IRA.

3.13.9.3 Cottonwood IRA

1. Soil, water, and air resources – Soil within the IRA is typical for the Project Area. Detailed information on soil resources within the Project Area can be found in Section 3.5.1. The portion of the IRA within the Project Area is located within the Antelope Creek watershed. Sowers Canyon runs along the eastern boundary of the IRA within the Project Area. Sowers Creek in Sowers Canyon represents the only perennial stream in the Project Area. Water from the IRA contributes to instream flows of the Duchesne River and supplies spring and pond water for livestock grazing within the area. More information on water resources within the Project Area can be found in Section 3.6. Air quality is regional in nature, and detailed information on air quality can be found in Section 3.2.
2. Sources of public drinking water – No public drinking water sources have been identified within the Project Area.
3. Diversity of plant and animal communities – The majority of the IRA in the Project Area consists of pinyon-juniper woodland; however, a few areas of coniferous forest and shrubland habitats exist in the southern portion of the IRA within the Project Area. A few shrub communities exist within and adjacent to the IRA in the Project Area. Some patches of greasewood and riparian vegetation exist along riparian corridors. A few grasslands exist adjacent to patches of rabbitbrush in the southwestern most portion of the IRA within the Project Area. Much of the IRA is used for livestock grazing. Some of the IRA has been designated by Utah Division of Wildlife Resources as high value winter range for deer and elk and summer habitat for pronghorn. Detailed information regarding plant and animal communities within the Project Area can be found in Sections 3.8 and 3.9, respectively.
4. Habitat for threatened, endangered, or sensitive species and species dependent on large undisturbed areas of land – No threatened or endangered species are expected to occur in the IRA due to lack of suitable habitat. Suitable habitat for sage-grouse, a candidate species, overlaps a portion of the IRA within the Project Area (see Figure 3-17). Information regarding Forest Service sensitive species and MIS in the Project Area can be found in Sections 3.9.1.2 and 3.9.1.3, respectively.
5. Primitive and semi-primitive classes of recreation – Cottonwood IRA contains 907 acres of semi-primitive non-motorized recreation class.
6. Reference landscapes for research study or interpretation – No Research Natural Areas or other reference landscapes for research study or interpretation exist within the IRA.
7. Landscape character and integrity – Natural systems within the IRA currently have moderate effects from livestock grazing, water uses, and vegetative treatments.
8. Traditional cultural properties and sacred sites – TCPs may exist within the IRA in the Project Area.
9. Other locally unique characteristics – No other locally unique characteristics are identified for this IRA.

3.13.10 Environmental Consequences

Wilderness attributes of untrammeled, apparent naturalness, undeveloped character, opportunities for solitude and primitive recreation, special features, and manageability

have been identified as standard for determining effects to wilderness potential in project NEPA (Welsh 2008). Based on comments received on the DEIS, an analysis of effects to roadless characteristics in 2000 inventoried roadless lands within the Project Area is also included.

The analysis is not provided as Roadless Rule compliance (see descriptions of court actions above). The Roadless characteristics evaluated are 1) soil, water, and air resources; 2) sources of public drinking water; 3) diversity of plant and animal communities; 4) habitat for threatened, endangered, or sensitive species and species dependent on large undisturbed areas of land; 5) primitive and semi-primitive classes of recreation; 6) reference landscapes for research study or interpretation; 7) landscape character and integrity; 8) TCPs and sacred sites; and 9) other locally unique characteristics.

3.14 Transportation

3.14.1 Affected Environment

U.S. Highway 191 bisects the South Unit to the west of the Project Area and is a travel corridor from Duchesne to Price, Utah. This 47-mile section of highway is designated as the Indian Canyon Scenic Byway. Current traffic volumes and accident rates are provided in Table 3-61. Access to other parts of the South Unit is provided by a network of Forest Service roads, but is limited by the rugged topography and lack of improved roads. Visitor use is relatively low in this area of the forest and is generally limited to hunting and hiking (Paulin 2006). The entire South Unit is open to motorized vehicles on designated routes and closed to cross-country travel (Forest Service 2007m).

Table 3-61. Current Traffic and Accident Information.

Highway Segment	U.S. 191 - from mile post 266.69 to 293.98
2006 Annual Average Daily Traffic (AADT)	535
% AADT that is Truck Traffic	46
Reported Crashes in 2005	31

Source: Utah Department of Transportation 2007, 2008

Air transportation available in the region includes Duchesne Municipal Airport to the north, Carbon County Regional Airport near Price, and Roosevelt Municipal Airport to the east. Railway transportation is available on Amtrak. This rail follows Interstate 6 between Green River and Salt Lake City, with stops in Helper and Provo.

The Project Area is currently traversed by several Forest Service and county-maintained roads as well as numerous unauthorized roads. The existing roads that pass through the Project Area are classified as Improved, which are suitable for passenger cars, and Unimproved, which are native surfacing and are suitable for four-wheel-drive or high clearance vehicles (Figure 3-25). Improved roads in the Project Area include Sowers Canyon (FSR 152), Nutters Ridge (FSR 333), and Left Fork Antelope Canyon (FSR 154). These roads, which travel through the Uintah and Ouray Indian Reservation to the north, have gravel or native surfacing. There is one non-motorized trail that passes through the southwest corner of the Project Area. The bare, erosive soils and steep slopes in the Project Area are susceptible to impacts from motorized use. The ANF has revised their Travel Management Plan (Forest Service 2009c) in accordance with the 2005 Forest Service management policy (*Travel Management; Designated Routes and Areas for*

Motor Vehicle Use; Final Rule [36 CFR Part 212]). The Travel Management Plan establishes a forest-wide system of designated routes and areas for motorized travel. For information on ORV use, refer to Section 3.12.1.2.

Portions of the Cottonwood, Sowers Canyon East, Nutters Canyon, and Alkali Canyon potential wilderness areas are located in the Project Area.

3.14.2 Environmental Consequences

This section identifies potential effects of the Proposed Action and alternatives on the transportation system providing access to county, state, BIA, and Forest Service roads. Impacts from the expanded road network and increased traffic are discussed. More detailed discussion of potential effects of new and improved roads on soils, noxious and invasive species, range resources, wildlife habitat, recreation resources, and visual resources are described in those sections within Chapter 3.

3.14.2.1 Impacts Common to All Alternatives

Under all alternatives, except the No Action Alternative, development in the Project Area would increase the number of roads within the Project Area, increase vehicle traffic in the Project Area, and increase traffic on roads used to access the Project Area. For the LOP and especially during development, traffic increases may cause congestion and road damage and an increased potential for vehicle collisions. It is assumed that transportation impacts would be greatest during development. Routes such as U.S. 191 would likely experience an increase in AADT, particularly truck traffic. Impacts to air and rail travel are not expected. Project-related traffic would include light and heavy trucks used for construction crews commuting to the site, equipment delivery and removal, water delivery, and site cleanup. The estimated truck traffic for the life of each well is summarized in Table 3-62. During the 36-day construction phase of a well, approximately 161 light trucks and 186 heavy trucks would drive to the well site. During the production phase, crude oil would be hauled off-site by truck at an estimated rate of one truck trip every eight days per well. Produced water at the well pads would be transported by tanker trucks to approved disposal sites or reused for drilling at other Operator locations.

Direct impacts from transportation include removal of vegetation and wildlife habitat. Table 3-63 compares the area of disturbance from roads for all alternatives. Vegetation would be removed during the construction of new roads and improvement of existing roads. Other impacts include an increase in fugitive dust, potential for erosion and sedimentation of streams, increased public access to the area, and decreased remoteness. The network of roads may also impact big game and other wildlife by increasing fragmentation and crossing migration routes (see Section 3.9.2).

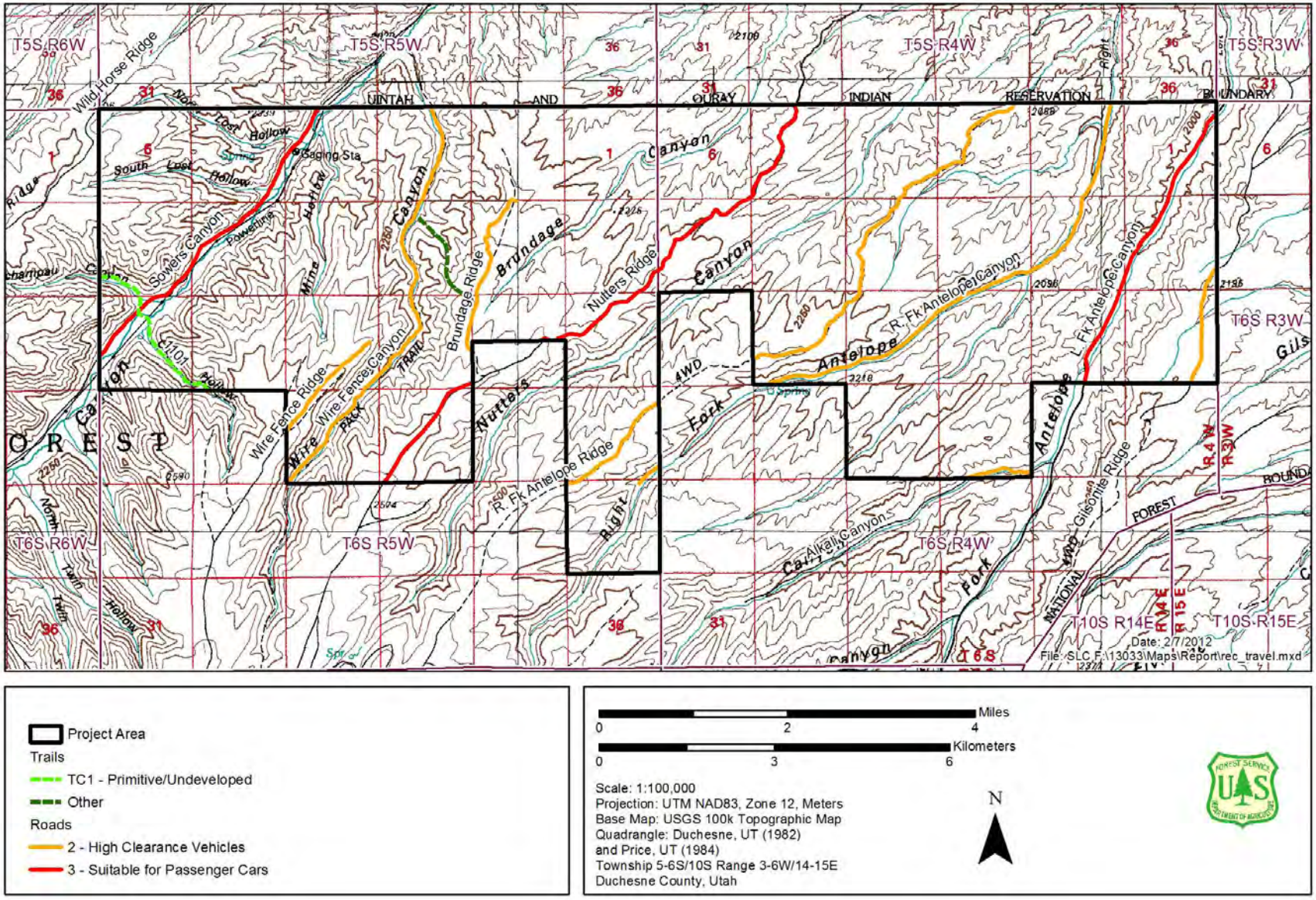


Figure 3-25. Existing Roads in the Project Area.

Table 3-62. Truck Traffic Estimate per Well.

Phase		Light Truck Trips	Heavy Truck Trips
I. Road and Pad Construction	Total	8.00	4.00
8 days per well	Avg/Day	1.00	0.50
II. Well Drilling	Total	88.00	92.00
7 days per well	Avg/Day	12.57	13.14
III. Well Completion	Total	51.00	76.00
14 days per well	Avg/Day	3.64	5.43
IV. Production Equipment Install	Total	14.00	14.00
7 days per well	Avg/Day	2.00	2.00
V. Production	Each Day	1.00	0.13
20 years per well			

Table 3-63. Surface Area Disturbance from Roads.

Disturbance	No Action	Alt 2	Alt 3[1]	Alt 4
Miles of Existing Roads Improved	0	20	20	20
Miles of New Roads	0	77	77	57
Acres Initial Disturbance	0	410	404	327
Acres Long-term Disturbance	0	205	200	152

[1]Actual impacts are expected to be less with implementation of BMPs.

Road drainage crossings would be of the typical dry creek drainage crossing type. The crossings would be designed so they do not cause siltation or accumulation of debris in the drainage crossing, and so the drainage flows are not blocked by the roadbed.

The improvement of existing roads may increase public access to the South Unit by improving unimproved roads to roads usable by passenger cars. All existing roads would remain open to the public and new roads would be closed to public travel. Signs would be placed at the entrance to new roads to deter public use and gates would be erected where feasible. IRA characteristics and resources would be impacted by increased road and well development.

Impacts due to traffic volume would be considered significant if the proposed project resulted in the inability of the Forest Service to meet the objectives of their revised Travel Management Plan or a change in IRA attributes.

3.14.2.2 Alternative 1 – No Action Alternative

Existing roads (39 miles) in the Project Area would remain the same. No additional access roads would be built in the South Unit and no improvements would be made to existing roads, related to the proposed project. Traffic volumes would remain at current levels. The Alkali Canyon and Nutters Ridge roadless/undeveloped areas would remain at the level described in the recent evaluation.

3.14.2.3 Alternative 2 – Proposed Action

The Proposed Action would include 77 miles of new access roads and 20 miles of upgraded existing roads (Table 3-63). The roads would use a 35-foot-wide construction ROW that would be reclaimed to a 22-foot road surface after well construction; some existing roads would be widened to 35 feet wide then returned to 22 feet wide. Therefore, the initial disturbance from road construction would be approximately 410 acres, and would be reduced to 205 acres after reclamation. Traffic could occur across the entire Project Area during the LOP as roads are developed. For each of the 400 wells, an estimated 161 light truck trips and 186 heavy truck trips would occur during the construction/drilling phase. Between 10 and 50 wells would be drilled each year over the 5- to 20-year drilling phase. Traffic would be reduced to approximately one light truck trip per day and one heavy truck every eight days for the 20-year production phase.

3.14.2.4 Alternative 3

Alternative 3 would also allow drilling up to 400 wells using a combination of up to 400 new and existing well pads; however, this alternative would construct new roads with each phase of development. A transportation plan would be submitted with each phase. Each phase would be designed to use a major existing road to access new roads and wells.

The idea of phased approach is to allow migratory wildlife to pass through a portion of the Project Area with minimal noise, traffic, and other construction-related activities during transition periods. Since well construction and road use would be concentrated within one section of the Project Area at a time, it is expected that vehicle collisions with migrating animals would be reduced. The number of truck trips would be similar to the Proposed Action; however, since construction would be concentrated, the driving distance for each of these trips may be reduced.

Under this alternative, a POD would be developed for each phase. The POD would outline ways to reduce surface disturbance from roads and reduce traffic during construction and production. Strategies may include clustering facilities, directional drilling, drilling multiple wells from one pad, and remote monitoring. These strategies would decrease habitat fragmentation and other wildlife impacts related to roads and traffic. The total miles of new and improved roads under this alternative would depend on the strategies chosen for implementation, but it is expected that it would be less than the Proposed Action. Also under Alternative 3, no well locations would be placed on slopes greater than 25%, which would slightly reduce the number of well pads that could be constructed and eliminate their associated roads.

3.14.2.5 Alternative 4

Alternative 4 would decrease the number of well pads to 162 and therefore reduce the miles of roads necessary to access wells. This alternative would have the least miles of roads and least acres of land disturbed by road upgrading and construction compared to the other action alternatives (Table 3-63). Unlike the Proposed Action that includes a concentrated area of development, wells would be spaced relatively evenly throughout the Project Area. Also, since construction would not be phased under this alternative, road construction and use would occur throughout the Project Area during the LOP. Alternative 4 would allow drilling up to 400 wells, so the number of truck trips could be similar to the Proposed Action. However, since multiple wells could be drilled from a single pad, the number of necessary truck trips is expected to be reduced.

3.14.3 Cumulative Impacts

Increased traffic from the project and other area projects would result in an increased potential for public traffic hazards and other safety and road maintenance concerns. Existing highways and Forest Service roads may be adequate to handle anticipated increased traffic, however combined with other activities there is a potential to impact existing roadway conditions and safety. Cumulative impacts on transportation are anticipated to be slightly beneficial as improved road conditions and increased revenues for state road improvements occur. Unavoidable adverse impacts to transportation would occur for the LOP primarily as a result of increased traffic and the expanded road network.

3.14.4 Mitigation

Detailed site specific transportation plans will be submitted with each application to drill. Transportation plans will include detailed route locations, drawings, gates, signage, erosion control, drainage, road maintenance, etc." (Appendix A) and summarized below.

- All existing and new access roads would be maintained and kept in good repair during all drilling, completion, and producing operations associated with the proposed oil and gas wells. Road maintenance would include grading, maintaining drainage, watering (as needed), fixing mud holes, cleaning cattle guards, snow removal, sign maintenance (for signs associated with oil and gas wells), etc. Snow removal will be done in a manner approved by the Forest Service in order to reduce road surface loss and erosion.
- New access roads and surface-disturbing activities would conform to the BLM Gold Book (BLM 2007) standards and/or Forest Service specifications.
- The road grade for new roads within the Project Area would be 10% or less wherever possible.
- If the disturbed road width needs to exceed 35 feet to accommodate larger equipment, intersections, or sharp curves, approval would be required from the Forest Supervisor. Turn-out areas would not be constructed unless deemed necessary for safety reasons and approved by the Forest Service.
- Graveling or capping the roadbed would be performed as necessary to provide a well-constructed, safe road.
- Reduce fugitive dust from roads by employing speed limits and applying water as needed Water obtained for this purpose would be fresh water, not production water. If water application does not adequately reduce fugitive dust, the use of magnesium chloride (MgCl) would be considered; however, MgCl should not be applied within 100 feet of perennial streams, wetlands, springs, wet areas, or ambient water. In proximity to such settings gravel surfacing or non-chloride dust suppressants would be considered.
- Appropriate water control structures for roads would be installed to control erosion.
- There would be no major cuts and fills, or bridges. If it becomes necessary to install a culvert at some time after approval of the APD, the Operator would submit a Sundry Notice requesting approval of the Forest Service AO.

- Road drainage crossings would be of the typical dry creek drainage crossing type. Crossings would be designed so they will not cause siltation or accumulation of debris in the drainage crossing, and drainages would not be blocked by the roadbed.
- There would be no gates, cattle guards, fence cuts, or modifications to existing facilities without prior consent of the Forest Service.
- In semi-primitive non-motorized/roadless areas, roads would be located, designed, and reclaimed in a manner that minimizes effects to the semi-primitive character of the land.
- All construction/operations traffic would be confined to the approved road ROW and any additional areas as specified in an approved APD.
- New access roads and other disturbed areas that are no longer needed would be restored to near their original condition and Forest Service reclamation procedures would be followed.
- The Operator should consult with the County, Utah Department of Transportation, and adjacent land managers (i.e., BIA) to ensure that roads serving the Project Area are adequately maintained and repaired.
- Contractors and employees are required to comply with all posted speed limits.
- Construction equipment used to construct well pads and roads would be cleaned of soil prior to entering forest lands in order to prevent the spread of noxious weeds.
- All new roads constructed by the Operator will be closed to the public through the use of Forest Service approved signs and gates.

3.15 Visual Resources

3.15.1 Affected Environment

The ANF currently uses the Forest Service Visual Management System (VMS) (Forest Service 1974) to inventory scenic quality and establish visual resource land management objectives within the proposed Project Area. This system is also used by the ANF to analyze potential project-related impacts to visual resources within its jurisdiction, and to determine if those potential impacts would meet Forest Plan VQOs. The resource indicators used to assess impacts to visual quality include 1) the number of acres of surface disturbance proposed for each of the alternatives, and 2) whether the surface disturbances would meet or exceed the designated VQOs for the Project Area.

The VMS system uses five VQOs (Table 3-64), which are visual ratings that are designated for an area, and are used to determine the degree of acceptable alteration of the natural landscape. The VQOs for an area are based on a balance of several factors that include the area's other resource management prescriptions (e.g., woodland and timber harvesting, livestock grazing, mineral potential), the area's visual or scenic quality, and the viewer‘s sensitivity to the landscape (i.e., the public's perception of the importance of scenery and scenic quality within an area) (Forest Service 1974).

The current LRMP manages the lands in the Project Area under the Modification VQO, which, as described in Table 3-64, allows activities to have visual impacts or contrasts that would visually dominate the existing landscape characteristics.

Visual Resource management is identified in the LRMP by management area through a prescription, goals and objectives, and standards or guidelines. Within the LRMP, the standards for management areas are:

MAs ~~–d~~" and ~~–e~~" - Adopted VQO standards include [the least restrictive inventoried of] Retention, Partial Retention, Modification, or Maximum Modification, and may be lower [than inventoried in order] to meet resource needs [if justifiable] within view sensitivity [level].

MA ~~–n~~" - Manage to meet VQO identified in inventory

All of the project area has inventoried VQOs of Modification or Maximum Modification. Modification was identified as the minimum VQO to meet the Forest Plan standards and other direction for the entire project area, since no higher (more restrictive) VQO was inventoried for the area, and no Sensitivity Level one or two views were identified.

Table 3-64. Forest Service Visual Quality Objective Description.

Modification	Modification allows management activities to visually dominate the original landscape characteristics. Those activities, however, must borrow from the naturally established line, form, color, and texture within the landscape to such a scale that the visual characteristics are visually compatible with the surrounding landscape. Activities such as roads and structure construction, and vegetation slash must remain visually subordinate. Visual impact reductions to meet this objective should be accomplished within one year or should meet existing regional guidelines.

3.15.2 Environmental Consequences

For the analysis of impacts to visual resources, impacts would be considered significant if the impacts of the proposed project do not conform to the Forest Service designated VQOs or management goals within the Project Area.

3.15.2.1 Methodology

The method of assessing whether impacts would meet designated VMS class VQOs is based on a subjective comparison of the existing landscape with the potential visual contrasts created by a proposed activity, in terms of landscape form, color, line, and texture. Landscape form refers to the unified masses or shapes of the landscape being analyzed, such as existing structures, topography, and natural objects (e.g., conical peaks, blocky mesas, rolling grassland). Landscape color refers to the landscape surface colors, as affected by viewing distance, atmospheric effects (e.g., haze, fog, dust), and time of day. Landscape textures are the variations, patterns, density, and graininess of the landscape surface (e.g., uneven, sparse, and seemly random-ordered shrubs in an arid landscape; even, orderly, and dense rows of trees in an orchard), and the dimensions of those surface variations (e.g., tall conifers, short grasses). Linear landscape features are the real or imagined paths that the eye follows when perceiving abrupt changes in form, color, or texture. These are often noticeable as the edge effect created at the boundary of two contrasting areas (e.g., a line of trees along a rocky slope or ledge; the abrupt boundary between forest and grassland; a dark ridgeline silhouetted against a bright sky).

The assessment is typically conducted from representative points of view where the potential line, color, form, and texture contrasts would be visible to the casual forest visitor and/or areas with high scenic quality and visual sensitivity. The potential project-

related line, form, color, and texture contrasts are then compared to the allowable level of visual disturbances for the proposed Project Area's designated VMS class VQOs.

The observation points and the existing landscape characteristics for assessing impacts to visual resources for the proposed project are in three locations, along Sowers Canyon in the western portion of the proposed Project Area, on Nutters Ridge near the center of the Project Area, and in the left fork of Antelope Canyon, near the eastern boundary of the Project Area (Figure 3-26). The landscape characteristics within the viewshed of the selected observation points are described below.

Observation Point 1 – Sowers Canyon Road/Quichampau Trail (Sowers Road)

This viewpoint is located at the intersection of Sowers Canyon Road and a backcountry hiking trail that crosses the road. From the observation point at the road intersection, the trail follows the Quichampau Canyon bottom to the northwest and Clem Hollow to the southeast. This observation point was selected because it would provide views of the Project Area from a recreation trail used by backcountry, primitive-use hikers and day hikers.

The topography within Sowers Canyon is variable and distinct, ranging from flat to gently rolling along the canyon floor through steep slopes along the canyon sides, to near-vertical, exposed rock escarpments at the tops of the canyon. Canyon landforms are symmetrical, composed of rounded hills that slope down to the canyon bottom at roughly equal angles along both sides of the canyon. Uniformly dense sagebrush is predominant within the canyon bottom, interrupted by patches of willow, and occasional clumps of low conifers. Uniformly dense conifers grow on the canyon slopes, with decreasing density down slope and on south-facing slopes.

Landscape line elements are distinct where the canyon slopes intersect the canyon bottom. Horizontal bands of rock strata are visible along the upslope escarpments. Strong linear elements also include the undulating ridgelines along both sides of the canyon, horizontal and vertical power line structures and lines that run along the canyon bottom, and the simple, strong, butte edge created by the contrast of the unvegetated, graded Sowers Road with dense roadside vegetation. The canyon road is tan, as are the unvegetated patches of exposed soil on the canyon slopes. Slope conifer vegetation is dark green. Canyon bottom colors are a variation of light and dark greens, tans, browns, and buff colors. The power line poles are distinctly dark brown. Landscape textures are somewhat even and coarse on the canyon slopes, caused by dense stands of conifers; textures are fine and evenly patterned along the canyon bottom. With the exception of the power line that runs along the canyon and trail signs, no other structures are visible.

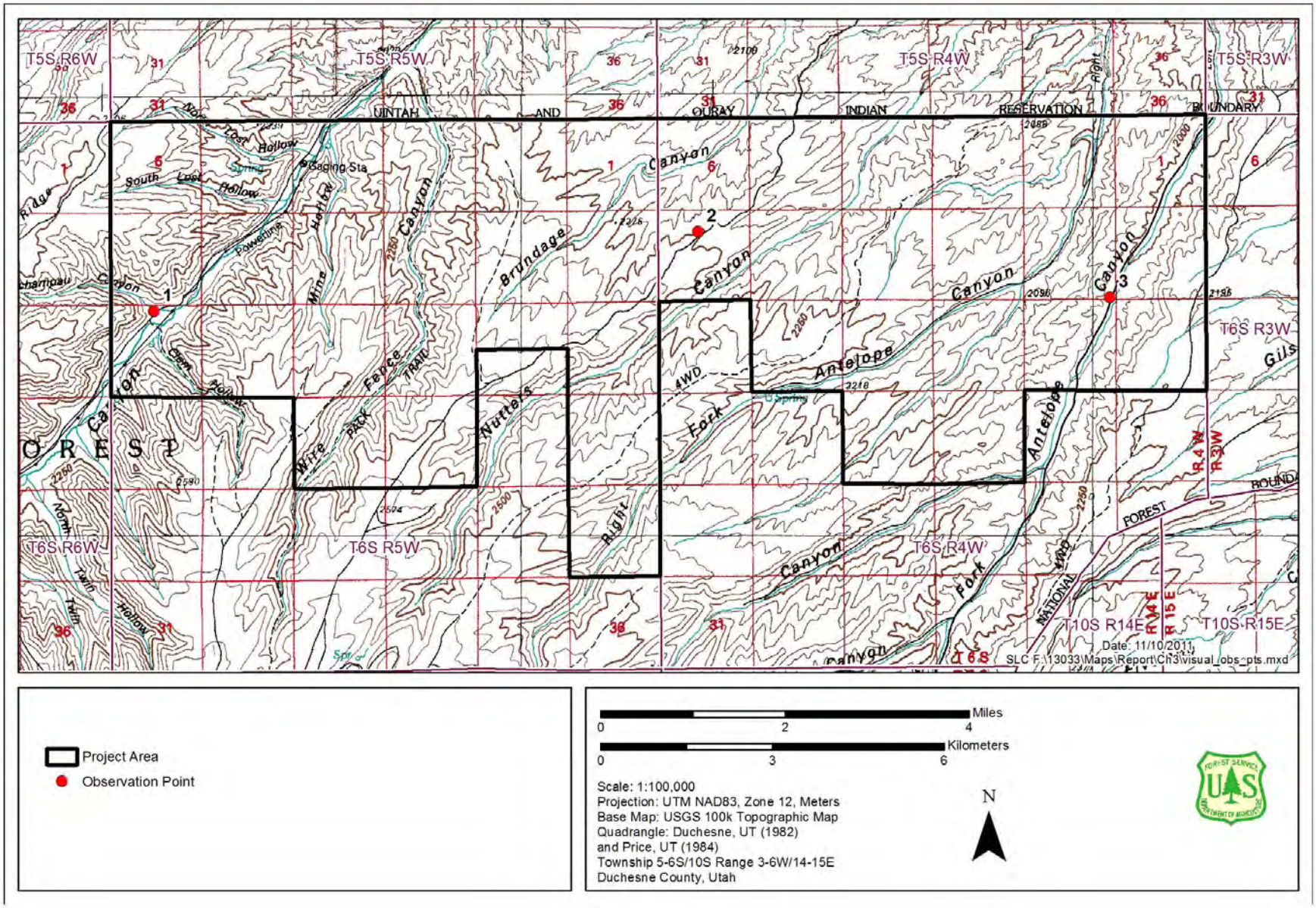


Figure 3-26. Visual Observation Points in the Project Area.

Observation Point 2 – Nutters Ridge Road (Nutters Road)

The Nutters Ridge observation point is located along the Nutters Ridge Road, roughly equidistant from the Uintah and Ouray Indian Reservation boundary to the north and the Project Area boundary intersection with Nutters Ridge Road to the south. This point was selected because Nutters Ridge Road is a maintained access road suitable for passenger vehicles, and because the road lies along a high ridgeline near the center of the proposed Project Area with relatively unobstructed panoramic views of the surrounding landscape.

Topography from the perspective of Nutters Ridge Road appears as generally north to south, flat to gently sloping ridges that run roughly parallel to the road and extend to the horizon. To the east, the ridges are separated by shallow swales or drainages. To the west, the ridges are separated by smooth, steep-sloped canyons, and also extend to the horizon. Strong landscape line contrasts are created by the bold and distinct ridgeline silhouettes with the sky and the underlying landscape. Moderately strong landscape lines are also created by dense strips of conifers growing along ridgetops and slope contours. Colors include reddish-tan soils and rock on the exposed canyon slopes with tan-colored soils in the foreground and within the road, dark green conifers, and light green and light tan-colored shrubs and forbs. Landscape textures consist of uniformly dense and patchy shrubs and grasses, sparse to dense clumps of conifers on the eastern slopes and ridges. Western slope textures include uniformly dense and even-spaced conifers on canyon slopes, with long dense strips on ridgetops. Textures are fine- to medium-grained from this observation point. No structures are visible from this viewpoint.

Observation Point 3 – Left Fork Antelope Canyon (Antelope Canyon)

The Antelope Canyon observation point is located along the canyon access road, approximately midway between the Uintah and Ouray Indian Reservation boundary to the north and the Project Area boundary intersection with the canyon access road to the south. Similar to the Nutters Ridge Road, this location was chosen because it provides access along the eastern portion of the Project Area with road conditions suitable for passenger vehicles, and would provide representative views of project-related well pad and access road construction along a canyon bottom.

Observation point views are to the north, where the majority of the proposed well pad and infrastructure construction is proposed. The valley form is fairly symmetrical. The topography on the east side of the roadway is flat to gently sloping on the canyon floor. The canyon side rises abruptly and steeply from the floor to a long, undulating ridgeline. Similarly, the topography on the west side of the road rises immediately, but more gently, to form the other valley side and a long, gently undulating ridge. There are no topographically bold or prominent features in this canyon, but strong landscape line contrasts are created by the edge effect of the canyon's graded roadway and dense vegetation that borders the road. Moderately strong lines are created along the canyon ridgelines. Moderate line contrasts are created where the canyon floor meets the steeply sloped canyon sides, and from lines of dense conifers that follow the valley slope contours. Colors include tan-colored exposed soil within the roadway, reddish-tan soils on the canyon side slopes, and dark green conifers on the canyon slopes. Light to dark green shrubs, grasses, forbs, and isolated conifers predominate along the canyon floor. Textures on the valley floor are fine, and are composed of uniformly dense shrubs; textures on the canyon slopes are also fine, composed of uneven, diffuse to patchy clusters of conifers and shrubs. No structures are obviously visible from this viewpoint.

Current Forest Visual/Scenic Management

The current LRMP manages the lands in the proposed Project Area under the Modification VQO, which, as described above in Table 3-65, allows activities to have visual impacts or contrasts that would visually dominate the existing landscape characteristics.

3.15.2.2 Impacts Common to All Alternatives

The potential direct adverse impacts to visual resources from the proposed project that would be common to all of the action alternatives would include the visual contrasts created by construction equipment, pipelines, well pads, construction equipment storage areas, temporary and permanent access roads, and other infrastructure associated with oil and gas exploration and development. In general, drilling rigs and equipment, construction and maintenance vehicles, development infrastructure, and the surface disturbances associated with well drilling, including well pad access roads, would impact scenic quality in the short term with human-made form, color, and line contrasts. The visual impacts from producing wells (including permanent access roads, permanent well pads, pipelines, maintenance vehicles, and related infrastructure [e.g., electrical generators, dehydrators]) would have similar visual contrasts with the natural landscape, and would persist in the long term throughout the production lifetime of the wells and during the LOP. Specifically, form contrasts would be created in the long term from recontouring slopes for well pad and access road construction, and in the short term from visually intrusive oil and gas exploration infrastructure (e.g., drilling rigs, construction vehicles); long-term line contrasts would be created from the strong surface disturbance edge effects along roads and well pads where vegetation is removed and soil is exposed, and from long lines of surface pipelines near roads and on visible slopes. Long-term color contrasts would be created from soil exposure during well pad and road construction, from exposed soil over trenches created for buried pipelines, and from the long-term presence of oil and gas production infrastructure and production well pads.

For up to approximately 30 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. During the operations phase of the proposed project, the presence of production equipment would still be noticeable at these locations, but site-specific visual resource mitigation would ensure that oil and gas-development-related impacts would comply with the Forest Service Modification VQOs for the Project Area.

The indirect visual effects of well exploration and development would include vehicle-related fugitive dust, which could adversely impact long-distance scenic quality; however, it is likely that these impacts would be short-term, and localized at a well drilling operation because drilling would generate dust only during the time required to drill the well (well production would have negligible impacts on fugitive dust production). In the 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 LOP. 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 within surface-disturbance areas. This, in turn, could increase the indirect risks of wildland fire, and potentially alter scenic quality in the short term and long term

because of the line and color visual contrasts created by fire. Short-term impacts on scenic quality from wildland fire would be within 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/forest areas (e.g., sagebrush, pinyon-juniper woodland), where re-growth 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. In the short term, the visual contrasts created by these structures and disturbances would diminish as vegetation becomes re-established.

Alternative 1 – No Action Alternative

Under the No Action Alternative, current surface disturbance within the proposed Project Area consists of 168 acres from the construction of 29 well pads and 39 miles of related access roads and pipelines. As discussed above, none of the wells and their related infrastructure is visible to casual view from the visual observation points. Therefore, the direct and indirect impacts to scenic quality would be negligible under this alternative.

Alternative 2 – Proposed Action

Under the Proposed Action, 1,361 acres would have surface disturbances caused by the 107 miles of associated access roads and buried pipelines including 77 miles of new road construction, 374 exploration and production well pads, and 4 compressor stations.

Sowers Road

Under the Proposed Action, a small number of wells in the vicinity of the hiking trail to the north and south of the trail along the Sowers Canyon road would likely be visible to hikers using the trail, and geographic information system (GIS)-based viewshed analysis indicates that at least four wells would be visible in the foreground from this viewpoint (one of which is close to the trail in Quichampau Canyon to the northwest). Drilling rigs would likely be visible in the short term within this Forest Service-designated Modification VQO area, and well pad and oil and gas production infrastructure would potentially be visible in the long term, with surface disturbance impacts as discussed under General Impacts above. The impacts to scenic quality for hikers would be adverse, caused by visible surface disturbances and oil and gas development infrastructure.

Nutters Road

From the Nutters Road observation point, visual analysis and GIS-based viewshed analysis shows that 35 wells would potentially be visible, including proposed wells in the background in Brundage Canyon, Nutters Canyon, and the Left Fork of Antelope Canyon. At least four wells would be visible in the foreground. Based on proposed well locations along the ridge road, it is likely that many of the wells located near or in the vicinity of the road would be visible to the casual viewer traveling along this public route. Exploration drilling rigs would be clearly visible at these locations in the short term, with other short-term and long-term adverse impacts to visual and scenic quality as discussed under General Impacts above. Site-specific mitigation would ensure that these surface disturbance-related impacts to visual resources complied with the Modification VQOs for the Project Area.

Antelope Canyon

From the observation point within the canyon, proposed well pads would be visible to the north and south along the road, and GIS viewshed analysis shows that two wells would be visible to the casual viewer traveling along this road. Based on the proposed location of other well pads along the canyon road, it is likely that most of the wells (at least 10 wells) and the proposed compressor station would be visible to casual viewers as they move along this road. The impacts to visual resources would be the same as discussed for Sowers Road.

Compared to the No Action Alternative, the Proposed Action would have more adverse impacts to scenic quality and visual resources because there would be more acres of surface disturbance from well pad development and access road construction, and surface pipelines. However, under the Modification VQOs, project activities may visually dominate the characteristic landscape, but must borrow from or repeat the naturally established line, form, color, and textures of that existing landscape so that they are compatible with that landscape. Visual resource mitigation (see below) would ensure that that project activities would be in compliance with designated Modification VQOs.

Alternative 3

Under this alternative, 1,355 acres within the proposed Project Area would be impacted by construction of 374 exploration and production well pads, 107 miles of associated access roads and buried pipelines including 77 miles of new road construction, and four compressor stations. Thus, the impacts to visual resources would be very similar to those discussed above under the Proposed Action.

Impacts to visual resources under Alternative 3 would be the same as discussed under the Proposed Action because practically the same number of wells would be drilled under this alternative. Therefore, the same number of wells would be visible to casual view from the observation points as would be visible from those under the Proposed Action.

Alternative 4

Under Alternative 4, 836 acres would be disturbed from the construction of 162 exploration and production well pads, 87 miles of access roads, including 57 miles of new road construction and surface pipelines, and four compressor stations.

Sowers Road

In the vicinity of the hiking trail and canyon road, the impacts to scenic quality would be the same as discussed under the Proposed Action, but to a lesser degree, as visual analysis and GIS viewshed analysis shows that fewer well pads would be visible from this location (at least three wells would be visible to hikers, one of which is close to the trail in Quichampau Canyon to the northwest).

Nutters Road

Under this alternative, visual analysis and GIS viewshed analysis shows that 12 wells would be visible throughout the Project Area (one well would be visible in the foreground from the observation point). The impacts to visual resources would be the same as discussed under the Proposed Action, but to a lesser degree, because fewer visible wells would have a reduced impact on visual resources, when viewed from the road.

Antelope Canyon

At the Antelope Canyon observation point, one well would be visible. However, based on the proposed location of other wells within the canyon, it is likely that at least five wells and a compressor station would be visible to casual view as travelers move along the canyon roadway. The impacts to visual quality would be the same as discussed under the Proposed Action, but to a lesser degree, because this alternative would have a reduced impact on existing visual resources.

Compared to the No Action Alternative, Alternative 4 would have more adverse impacts on scenic and visual quality within the proposed Project Area. This is because more area would be impacted by project-related surface disturbances and visually intrusive project infrastructure than under the No Action Alternative. However, Alternative 4 would have less impact to the visual resource than the Proposed Action or Alternative 3.

3.15.3 Cumulative Impacts

Cumulative impacts for visual resources would include the proposed project activities and activities within the Brundage Canyon gas field to the north on the Uintah and Ouray Indian Reservation. Direct cumulative impacts would include a reduction in scenic or visual quality along travel routes that pass through Reservation lands and Forest Service-administered public lands, caused by visible surface disturbances from oil and gas exploration and production surface disturbances, and pipelines. Cumulatively, the indirect impacts would be as described above under General Impacts. Fugitive dust production and degradation of long distance viewing, and increased opportunities for non-native vegetation establishment with subsequent increases in wildland fire risks would be increased on a regional scale. The impacts would be adverse for visual and scenic quality as landform, color, and linear landscape alterations would persist in the long term in this portion of the Uintah Basin.

3.15.4 Mitigation

Mitigation measures to reduce the impacts to visual resources would be the same under all alternatives. Mitigation would be applied site-specifically, based on the unique conditions that exist at each well pad location. The Forest Service VMS mitigation measures to meet or comply with the Modification VQOs for the Project Area would be designed to reduce the line, form, color, and texture changes to the existing landscape. As described above, project-related alterations of visual resource and scenic quality are allowed to dominate the landscape, but vegetation, landform, and facility structure must borrow from the existing landscape features to the degree that they are compatible with the surrounding natural landscape. Techniques to aid in accomplishing the site-specific requirements of the Modification VQOs would include the following.

- Facilities should incorporate appropriate camouflage coloring, facility design, proper placement, edge "feathering" along roads and vegetation/road boundaries, and/or topographic screening to reduce or eliminate the casually observable effects of well pads, access roads, and pipeline infrastructure.
- Topographic screening and proper placement of well pads and facilities could include hiding well pads and/or facilities behind ridge lines, in natural depressions, behind vegetation, or behind rock outcrops.
- Where feasible, facility design should include combining facilities to minimize the number of structures, burying part of the structure, using natural-appearing forms, or

using low-profile structures (where taller structures or tanks would be more visible) to reduce visibility and minimize form contrasts.

- Reduce the proposed well pad size to the minimum necessary to minimize color and line contrasts.
- Design access roads, when feasible, to follow landform or vegetation contours to reduce linear contrasts.
- Plan for and apply interim or intermediate well pad site and access road reclamation to reduce the visual size of surface disturbances and reduce color and line contrasts.
- Avoid excessive side-casting of earth materials from ridgelines and steep slopes to reduce soil color contrasts.

3.16 Socioeconomics

3.16.1 Affected Environment

This section describes the existing population, economic, social, and housing conditions, financial resources, and facilities and services in the socioeconomic study area to help analyze potential impacts from the proposed project on social or economic conditions.

The study area for this analysis includes the communities most likely to be affected by the proposed project. These include Duchesne County, the city of Duchesne, and the city of Roosevelt, located in the state of Utah. Uintah County is also discussed in the population, employment, and housing sections, as it is likely that a portion of individuals employed by the proposed project would come from the area. Project impacts are not anticipated to be related to public facilities, taxes, and revenues in Uintah County; therefore, these are not addressed for Uintah County. Other towns or cities within Duchesne County, as well as all towns and cities in Uintah County, were also excluded from analysis because of their size or distance from the Project Area.

This discussion describes the social and economic conditions of Duchesne County in northeastern Utah and, when appropriate, communities in proximity to the Project Area that may be impacted by the project. The discussion of Duchesne County is also focused primarily on the cities of Duchesne and Roosevelt because they are the major population centers in the county.

3.16.1.1 Population and Demographics

Utah

The state of Utah has experienced moderate growth in the past 20 years. Between 1990 and 2000, the population increased 29.6%; and another 23.8% between 2000 and 2010. In 2000, Utah had an average population density of 27.2 persons per square mile (U.S. Census Bureau 1990, 2000a, 2006a); in 2010 the average population density increased to 33.6 persons per square mile (U.S. Census Bureau 2010a). Table 3-65 summarizes the historical, current, and projected population for areas affected by the study area.

Duchesne County

The population of Duchesne County was 14,371 in 2000, up from 12,645 (13.7%) in 1990. The population of Duchesne County continued to increase between 2000 and 2010, reaching a population of 18,607, or a 29.5% increase (U.S. Census Bureau 1990, 2000a,

2010b). Duchesne County is expected to have a population of 20,130 by 2020, an 8.2% increase from 2010. In 2010, Duchesne County had a population density of 5.7 persons per square mile and a median age of 29.7 years, compared to a median age of 29.2 years for the state (U.S. Census Bureau 2010a, 2010c).

The cities of Duchesne and Roosevelt are most likely to be affected by the proposed project. Duchesne showed a moderate population increase of 7.7% between 1990 and 2000, and 20% between 2000 and 2010. The city of Duchesne has a median age of 30.4 years. Roosevelt grew 9.8% between 1990 and 2000, and 40.6% between 2000 and 2010. In 2010, Roosevelt had a median age of 26.2 years, which was somewhat lower than the state median age of 29.2 years (U.S. Census Bureau 2010d, 2010a). Selected age and education characteristics of the communities within the study area are summarized in Table 3-66.

Table 3-65. Comparative Historical and Projected Populations for the Study Area and the United States.

Location	Population*			% Change*		Projected Population	
	1990	2000	2010	1990–2000	2000–2010	2020	2030
U.S.*	248,709,873	281,421,906	308,745,538	13.2%	9.7%	335,804,000	363,854,000
Utah	1,722,850	2,233,169	2,763,885	29.6%	23.8%	3,652,547	4,387,831
Uintah County	22,211	25,224	32, 588	13.6	23.8%	32,300	33,127
Duchesne County	12,645	14,371	18,607	13.7%	29.5%	20,130	21,553
City of Duchesne	1,308	1,408	1,690	7.7%	20%	1,946	2,082
City of Roosevelt	3,915	4,299	6,046	9.8%	40.6%	6,048	6,468

*U.S. Census Bureau 1990, 2000a, 2004, 2006b, 2010a, 2010b, 2010c, 2010d, 2010e, 2010f, 2010g

Sources: Governor‘s Office of Planning and Budget 2008; Economic Development Corporation of Utah 2007, 2010a, 2010b
-- indicates field where data are not available.

Uintah County

The population of Uintah County was 25,224 in 2000, up from 22,211 (13.6%) in 1990. According to the U.S. Census Bureau, the population of Uintah County continued to increase between 2000 and 2010, to a population of 32,588, an 23.8% increase (U.S. Census Bureau 1990, 2000a, 2010e). In 2010, Uintah County had a median age of 29.7 years, compared to a median age of 27.1 years for the state (U.S. Census Bureau 2010e).

Table 3-66a. Selected Age Characteristics (2010)

	Utah	Uintah County	Duchesne County	City of Duchesne	City of Roosevelt
Median Age	29.2	29.1	29.7	30.4	26.5
Number of households	877,692	10,563	6,003	505	1,887
Average household size	3.10	3.07	3.05	3.05	3.15

Source: U.S. Census Bureau 2010a, 2010b, 2010c, 2010d, 2010e

Table 3-66b. Selected Education Characteristics (2000)

	Utah	Uintah County	Duchesne County	City of Duchesne	City of Roosevelt
School Enrollment					
Elementary school	41.2%	49.6%	51.1%	54.7%	49.3%
High school	22.2%	28.5%	28.2%	27.6%	27.6%
College	25.2%	9.7%	9.5%	7.4%	10.3%
Education of Population over 25 Years of Age					
Less than high school	12.3%	20.2%	19.0%	21.9%	15.4%
High school graduate	24.6%	36.0%	37.7%	32.7%	31.9%
Some college	29.1%	24.8%	25.1%	26.6%	28.2%
College or graduate degree*	26.2%	13.1%	12.7%	12.1%	19.2%

* Does not include Associate‘s degrees awarded.
Source: U.S. Census Bureau 2000b, 2000c

3.16.1.2 Economic Sectors and Employment

In 2009, state and local government provided the greatest share of employment in Duchesne County. The largest single employer is the County School District, with between 500 and 999 individuals in the work force, followed by the Uintah Basin Medical Center, New Field Exploration Company, and RN Industry Trucking. Table 3-67 summarizes major employers in the study area.

Table 3-67. Major Employers in Duchesne County, 2009.

Company	Number of Full-Time Employees
Duchesne County School District	500–999
Uintah Basin Medical Center	500–999
New Field Exploration Co.	250–499
RN Industry Trucking	250–499
Cash Meat Market	100–249
Duchesne County	100–249
Frontier Drilling	100–249
Nile Chapman Construction	100–249
RJ Taylor Welding and Construction	100–249
Second Nature Therapeutic Practice	100–249
State of Utah	100–249
Uintah Basin Telecommunications	100–249
Unit Drilling Company	100–249
Western States Company	100–249

Source: Economic Development Corporation of Utah 2010a

The government sector is the primary industry in Duchesne County, as evidenced by the levels of employment identified in Table 3-68 (15.0%). Mining accounted for 14.7% of total employment in Duchesne County, followed by construction at 11.5%, retail trade at 9.4%, and transportation and warehousing at 8.7%. Some of the fastest growing employment sectors in Duchesne County between 2001 and 2008 have been in mining (178.4%), transportation and warehousing (159.3%), construction (138.6%), and real estate rental and leasing (119.0%).

Table 3-68 Employment by Industry, 2001 and 2008.

Total Employment by Industry	Utah				Uintah County				Duchesne County			
	2001	2008	% Change	% of 2008 Total	2001	2008	% Change	% of 2008 Total	2001	2008	% Change	% of 2008 Total
Total Employment	1,393,316	1,702,493	22.2%	100.0%	14,129	20,553	45.5%	100.0%	8,041	12,295	52.9%	100.0%
Farm Employment	20,418	18,921	-7.3%	1.1%	999	972	-2.7%	4.7%	991	881	-11.1%	7.2%
Non-farm Employment	1,372,898	1,683,572	22.6%	98.9%	13,130	19,561	49.0%	95.2%	7,050	11,414	61.9%	92.8%
Private Employment	1,165,611	1,453,673	24.7%	85.4%	10,492	16,794	60.1%	81.7%	5,460	9,569	75.3%	77.8%
Forestry, fishing	3,006	3,360	11.8%	0.2%	87	91	4.6%	0.4%	85	120	41.2%	1.0%
Mining	8,859	16,203	82.9%	1.0%	1,914	4,080	113.2%	10.0%	648	1,804	178.4%	14.7%
Utilities	4,357	4,407	1.1%	0.3%	137	146	6.6%	0.7%	45	44	-2.2%	0.4%
Construction	95,865	124,746	30.1%	7.3%	858	1,646	91.8%	8.0%	593	1,415	138.6%	11.5%
Manufacturing	127,588	133,810	4.9%	7.9%	263	373	41.8%	1.8%	166	265	59.6%	2.2%
Wholesale trade	45,973	54,707	19.0%	3.2%	400	762	90.5%	3.7%	147	227	54.4%	1.8%
Retail trade	161,781	187,436	15.9%	11.0%	1,735	2,211	27.4%	10.8%	946	1,152	21.8%	9.4%
Transportation and warehousing	47,873	56,417	17.8%	3.3%	481	1,179	145.1	5.7%	413	1,071	159.3%	8.7%
Information	36,548	36,353	-0.5%	2.1%	(D)	(D)	--	--	152	215	41.4%	1.7%
Finance and insurance	77,876	107,878	38.5%	6.3%	337	673	99.7%	3.3%	192	288	50.0%	2.3%
Real estate and rental and leasing	52,635	99,705	89.4%	5.9%	417	864	107.2%	4.2%	226	495	119.0%	4.0%

Total Employment by Industry	Utah				Uintah County				Duchesne County			
	2001	2008	% Change	% of 2008 Total	2001	2008	% Change	% of 2008 Total	2001	2008	% Change	% of 2008 Total
Professional and technical svcs	80,872	110,933	37.2%	6.5%	(D)	630	--	3.1%	(D)	239	--	1.9%
Mgmt of companies & enterprise	21,814	21,638	-0.8%	1.3%	(D)	(D)	--	--	(D)	(D)	--	--
Administrative & waste services	78,362	95,888	22.4%	5.6%	382	(D)	--	--	128	(D)	--	--
Educational services	31,517	42,031	33.4%	2.5%	133	94	-29.3%	0.5%	(D)	89	--	0.7%
Health care and social assistance	102,721	133,244	29.7%	7.8%	822	1,041	26.6%	5.1%	(D)	605	--	4.9%
Arts, entertainment, and recreation	28,156	34,258	21.7%	2.0%	201	124	-38.3%	0.6%	60	114	90.0%	0.9%
Accommodation and food services	87,333	103,589	18.6%	6.1%	864	1,096	26.9%	5.3%	329	509	54.7%	4.1%
Other services	72,475	87,070	20.1%	5.1%	834	1,075	28.9%	5.2%	497	665	33.8%	5.4%
Government	207,287	229,899	10.9%	13.5%	2,638	2,767	4.9%	13.5%	1,590	1,845	16.0%	15.0%
Federal civilian	32,970	35,371	7.3%	2.1%	406	404	-0.5%	2.0%	89	87	-2.2%	0.7%
Military	16,880	16,540	-2.0%	1.0%	133	129	-3.0%	0.6%	75	73	-2.7%	0.6%
State and local	157,437	177,988	13.1%	10.5%	2,099	2,234	6.4%	10.9%	1,426	1,685	18.2%	13.7%

(D) = Not shown to avoid disclosure of confidential information, but the estimates for this item are included in the totals.
-- = no data available
Source: Bureau of Economic Analysis 2007

Uintah County

State and local government provide the greatest share of employment in Uintah County. The largest single employer is the County School District, with between 500 and 999 individuals in the work force, followed by Halliburton Energy Services, Uintah County, the Ute Indian Tribe, and Wal-Mart. Table 3-69 summarizes major employers in the study area.

Table 3-69. Major Employers in Uintah County, 2009.

Company	Number of Full-Time Employees
Uintah County School District	500–999
Halliburton Energy Services, Inc.	250–499
Uintah County	250–499
Ute Indian Tribe	250–499
Wal-Mart	250–499
Ashley Valley Medical Center, LLC	100–249
Bureau of Land Management	100–249
BJ Services Company	100–249
Caza Drilling, Inc.	100–249
Craig‘s Roustabout Service	100–249
Deseret Generation	100–249
Lowes	100–249

Source: Economic Development Corporation of Utah 2010b

Government is the primary industry in Uintah County, as evidenced by the levels of employment identified in Table 3-69 (13.5%). Retail trade accounts for 10.8% of total employment in Uintah County, followed by mining at 10.0 %. Some of the fastest growing employment sectors in Uintah County between 2001 and 2008 have been in transportation and warehousing (145.1%), mining (113.2%), real estate rental and leasing (107.2%), finance and insurance (99.7%), and construction (91.8%).

3.16.1.3 Income Characteristics

Per capita income was $12,337 in the city of Duchesne and $11,945 in the city of Roosevelt (U.S. Census Bureau 2000c). Per capita income is often used as a measure of economic performance, but it should be combined with changes in earnings for a realistic picture of economic health. Since total personal income includes income from 401(k) plans as well as other non-labor income sources like transfer payments, dividends, and rent, it is possible for per capita income to rise even if the average wage per job declines over time. In other words, non-labor sources of income can cause per capita income to rise, even if people are earning less per job.

Duchesne County

Per capita income for Duchesne County was $12,326 in 2000 and rose to $38,156 in 2008 (Bureau of Economic Analysis 2010). As shown in Table 3-70, the median household income for Duchesne County of $31,298 is 32% lower than the state‘s median household income of $45,726. The cities of Duchesne and Roosevelt have similar median household incomes to the county averages at $32,426 and $29,190, respectively. In 2009, the median household income rose to $45,934 (Economic Development Corporation 2010a).

Uintah County

Per capita income for Uintah County was $13,571 in 2000 and increased to $33,272 by 2008 (Bureau of Economic Analysis 2010). As shown in Table 3-70, the median household income for Uintah County of $34,518 is 24.5% lower than the state‘s median household income of $45,726. In 2009, the median household income rose to $50,259 (Economic Development Corporation 2010b).

Table 3-70. Income Characteristics, 2000.

Location	Per Capita Personal Income	Median Household Income	Median Family Income
Utah	$18,185	$45,726	$51,022
Uintah County	$13,571	$34,518	$38,877
Duchesne County	$12,326	$31,298	$35,350
City of Duchesne	$12,337	$32,426	$37,174
City of Roosevelt	$11,945	$29,190	$32,328

Source: U.S. Census Bureau 2000c.

3.16.1.4 Labor Force

Both labor force and employment have increased throughout the study area, however in recent years, the unemployment rate has also increased. Labor force statistics reflect employment by residence, unlike employment by sector statistics, which reflect employment by work location. Utah‘s labor force increased by 20.1% between 2000 and 2009, while Duchesne County‘s labor force increased by 70.7%, and Uintah County‘s increased by 55.6% in the same time period. Unemployment rates also served as a microcosm of the economic crisis experienced nationally. Utah‘s unemployment nearly doubled from 2000 to 2009 while Duchesne County‘s unemployment rate increased by 3.3% and Uintah County‘s by 2.7%. Recent data at the city level was not available. Table 3-71 provides a detailed summary of labor force and employment data for the study area between 1990 and 2000.

Table 3-71. Labor Force Summary, 2000 and 2009.

Location	Labor Force		Employed		Unemployed		Unemployment Rate (%)	
	2000	2009	2000	2009	2000	2009	2000	2009
Utah	1,136,036	1,364,495	1,097,915	1,274,788	38,121	89,706	3.4	6.6
Uintah County	11,339	17,647	10,858	16,328	481	1,319	4.2	7.5
Duchesne County	6,095	10,404	5,794	9,616	301	788	4.9	7.6

Source: Department of Workforce Services 2010.

3.16.1.5 Quality of Living

The effect of demand from the oil and gas industry on housing, law enforcement, health care, education, and other public facilities and services during the 1970s oil boom in Duchesne County was dramatic and had a significant impact on the availability and cost of these resources. Duchesne County, in particular the cities of Duchesne and Roosevelt, could experience the same type of ~~"~~boom" cycle as the demand for oil and gas increases in the area. Following is a discussion of housing, crime, and public facilities and services that could be impacted as a result of the proposed project.

Housing

Characterization of the existing housing situation is difficult to quantify because housing availability and price change daily and there are gaps in the availability of recent data. The following sections characterize the existing condition of housing based on U.S. Census Bureau data.

Utah

According to the U.S. Census Bureau, in Utah in 2010, 102,017(10.4%) vacant units were available for rental and ownership; in 2000, the vacancy rate was lower at 67,313 units (8.8%). Of the total available housing (979,709) in the state in 2010, 70.4% were owner-occupied, and 29.6% were renter-occupied. The median home price in 2000 was $146,100; by 2010 the price was $208,100, a 42.4% increase in the 10-year period. There were 13,463 single family home building permits issued in 2000 and 20,912 in 2005. More recent data for Utah were not available.

Duchesne County

In 2010, Duchesne County had 3,490 (36.8%) vacant units, 4,648 (77.4%) owner-occupied units, and 1,355 (22.6%) renter-occupied units. The median home price in 2000 was $81,800 and by 2010 the median value increased 77.4% to $145,100. There were 46 single family home building permits issued in 2000 and 125 in 2005. More recent data for Duchesne County were not available.

Duchesne

As of 2010, the city of Duchesne had a total of 582 housing units. Of these, there were 77 (13.2%) vacant units, 371 (73.5%) owner-occupied units, and 134 (26.5%) renter-occupied units. These rates are similar to the state numbers, and the vacancy rate can vary seasonally and from year to year. The median home price in 2000 was $82,000. Unlike the state and county, the median value decreased 7.68% over the next 5 years to $75,700 in 2005. Eight single family home building permits were issued in 2000 and seven in 2005. More recent data for Duchesne were not available.

Roosevelt

The city of Roosevelt had 2,067 total housing units in 2010; of these, there were 180 (8.7%) vacant units, 1,271 (67.4%) owner-occupied units, and 616 (32.6%) renter-occupied units. Roosevelt has a marginally higher percentage of renter-occupied units than Duchesne and the county. The median home price in 2000 was $78,400, and like Duchesne, the value decreased 7.65% over the next 5 years to $72,400 in 2005.

Interestingly, even though there was a decrease in the median home value, there was an increase in the number of single family home building permits issued between 2000 (n = 7) and 2005 (n = 12). More recent data for Roosevelt were not available.

Uintah County

Given the recent oil and gas boom in the Uintah Basin, there is a substantial housing shortage in the area, though the number of vacant units in the County increased from 853 in 2000 to 1,409 in 2010. Hotels, homes, and apartments are all full, with waiting lists for rental opportunities. Due to the shortage, oil and gas companies have even provided mobile homes on the project sites to provide housing for workers. Companies are attempting to build new housing to accommodate the need (Johnson 2006).

In 2010, Uintah County had 11,972 total housing units; of these, there were 1,409 (11.8%) vacant units, 7,885 (74.6%) owner-occupied units, and 2,678 (25.4%) renter-occupied units. The median home price in 2000 was $84,800. In 2010, the median home price was $169,800, a 100.2% increase over the 2000 price.

3.16.1.6 Crime

Utah

The Utah Department of Public Safety, Bureau of Criminal Investigation (BCI 2007) produces annual reports on crime statistics for the state of Utah. Crime data are compiled from the Uniform Crime Reporting (UCR) records submitted to the BCI by law enforcement agencies across the state. The UCR program defines crime rates as representing the number of crimes in relation to a population of a given jurisdiction. As such, crime rates are often used to compare crime in different areas. Serious offenses reported in UCR data are categorized as violent crimes (murder, forcible rape, robbery, and aggravated assault) or as property crimes (burglary, larceny theft, and motor vehicle theft). Crime rates are calculated by dividing the number of offenses by the total population and multiplying the result by 1,000. Census estimates for 2000, 2005, and 2008 were used as base population figures for calculating crime rates (Table 3-72).

Based on information provided in UCR annual reports, crime rates for both violent and property crimes were calculated for the Duchesne County Sheriff's Office (DCSO) and the Roosevelt Police Department (RPD). The DCSO reported a crime rate of 19.63 in 2005, an increase of 38.2% from 2000, and 13.43 in 2008, a decrease of 31.58% from 2005. On the other hand, the RPD reported a drastic decrease from 2000 to 2005; the reported crime rate was 73.97 in 2000, and that rate dropped 47.73% in 2005 to 38.66 and continued to drop 9.42% to 35.02 in 2008. This overall decrease can be largely attributed to a significant drop in reported larceny.

3.16.1.7 Public Facilities and Services

County and community profile information was primarily obtained from state and community websites. There are six cities within Duchesne County, the largest of which is Roosevelt. Duchesne County provides typical county government services, including a county assessor, county attorney, county commissioners, treasurer, road department, planning, landfill, emergency services, sheriff, search and rescue, parks and recreation, and libraries. The cities of Duchesne and Roosevelt provide similar municipal services, including administration, public works, police, fire, and parks and recreation services.

3.16.1.8 Law Enforcement and Fire Protection

Duchesne County is served by the DCSO. As of 2010, the DCSO employed 40 sworn law enforcement officers, 15 of which are road deputies, 25 correctional officers, and 15 civilian employees, totaling 55 full-time employees. The Duchesne County jail is located in the city of Duchesne. The DCSO also has a 36-member volunteer Search and Rescue Unit, one police dog, and five Uinta Mountain Search Dogs. The county is served by the Duchesne County Fire Department (DCFD), an all-volunteer fire department. The DCFD has seven stations and nearly 100 volunteers (DCSO 2007).

The city of Roosevelt is served by the RPD, which had 11 full-time employees in 2005: nine law enforcement officers and two civilian employees. There is no jail or holding cell in Roosevelt. The city is served by the RFD, which is also an all-volunteer department with nearly 20 volunteers. The RFD serves the city, and also assists and responds to calls in unincorporated portions of Duchesne and Uintah counties.

The city of Duchesne employs three part-time police and 13 part-time fire employees, though the city does not have its own police department. There are no full-time police or fire employees for the city. The DCSO and DCFD supplement police and fire services to the city.

3.16.1.1 Health Care

Medical care for Duchesne County is provided by the Uintah Basin Medical Center (formerly the Duchesne County Hospital), located in Roosevelt. The hospital has 42 beds and provides the following essential services: 24-hour emergency room, obstetrics, critical care capabilities, medical/surgical services, and dialysis. Roosevelt also has a nursing home and the city of Duchesne has the Duchesne Valley Medical Clinic.

3.16.1.2 Education

Public education in Duchesne County is provided by the Duchesne County School District, which includes 14 schools and close to 4,000 students (Duchesne County Chamber of Commerce [DCCC] 2010). The district includes seven elementary schools, three high schools, one junior high school, one kindergarten through 12th grade school, one middle school, and one special school. There is one elementary school (~600 students), a middle school (~480 students), a junior high school (~400 students), and a high school (~880 students) in Roosevelt; and an elementary school (~330 students) and a high school (~300 students) in Duchesne. In addition to the public education opportunities in Duchesne County, Roosevelt also hosts the Uintah Basin Area Technology Center, and Utah State University's Uintah Basin Education Center (DCCC 2007).

Table 3-73. Crime Incidence Counts and Rates for the Duchesne County Sheriff and Roosevelt Police Department.

	2000		2005		2008	
	Duchesne County	Roosevelt Police Department	Duchesne County	Roosevelt Police Department	Duchesne County	Roosevelt Police Department
Homicide	0	0	0	0	0	0
Rape	5	5	3	3	4	1
Robbery	1	4	0	0	0	1
Aggravated Assault	6	9	5	3	13	3
Burglary	31	32	42	8	35	21
Larceny	92	256	141	153	95	142
Motor Vehicle Theft	8	10	20	8	11	7
Arson	0	2	1	1	1	1
Total Index Crime	**143**	**318**	**212**	**176**	**159**	**176**
Crime Rate (per 1,000 people)	14.20	73.97	19.63	38.66	13.43	35.02
% Change 2000-2005	47.73%		+38.2%	-		
% Change 2005-2008					-31.58%	-9.42%
% Change 2000-2008	-5.42%	-52.49%				

Source: Bureau of Criminal Investigation 2007

3.16.1.3 Utilities

Water, sewer, and garbage services in Roosevelt are provided by the city. Water is pumped by the Roosevelt Municipal Water System, from five wells located roughly 10 miles away in Neola, Utah. Roosevelt uses a four-lagoon treatment system, constructed in 1976, to treat effluent waste water. The system can serve up to 12,000 people; however, only about one-half of that capacity is currently being used. Electricity to Roosevelt is provided by Moon Lake Electric Association, a rural electric cooperative, which serves over 17,000 consumers in northeastern Utah and western Colorado. The company has a district office in Duchesne, though the headquarters are in Roosevelt. Questar Gas Company is the provider of natural gas and propane in Duchesne; the company manages and operates transmission pipelines in the area (DCCC 2007).

Water, sewer, and garbage services in Duchesne are provided by the city. Water to the city and vicinity comes from the nearby Starvation Reservoir, delivered by the Duchesne Water System. The city also has a water treatment plant adjacent to Starvation Dam, that treats roughly 1,500 acre-feet (2.5 million gallons per day) (State of Utah Natural Resources 2001). Like Roosevelt, electricity in Duchesne is provided by Moon Lake Electric Association and natural gas and propane is provided by Questar Gas Company.

Electricity services to the southern part of Duchesne County are provided by Pacific Power, which is operated as ―Utah Power" in Utah and Idaho. Water, water treatment, sewer, and garbage services in the county are provided by different municipal services. Telephone service to Duchesne County, and the cities of Duchesne and Roosevelt, is provided by US West Communications and Strata Communications.

3.16.1.4 Taxes and Revenues

Overview

Only those revenues that are clearly and concisely reported by the state (i.e., property taxes, centrally assessed taxes, payments in lieu of taxes [PILT], sales and use tax, severance taxes, etc.) are discussed in this section (Utah State Tax Commission 2006). Where available, revenue information was reported at the county and city level; however, information of this type is limited.

Property (Ad Valorem) Taxes

Property taxes and tax rates in Utah are established, imposed, and collected at the local level. The tax is based on assessed values established by county assessors, although the Utah State Tax Commission values some specific properties such as mines, utilities, and railroads. All property tax collected by the counties is distributed to local government entities, school districts, and special districts. The Uniform School Fund, a statewide tax rate, is also imposed to finance and support Utah schools.

All taxable property in Utah is valued based on its location and the property status as of January 1 of each year; taxable property is assessed based on 100% of its fair market value, though primary residential property received a 45% exemption. The total taxable value of all locally assessed property in Duchesne County in 2009 totaled $11,025,941, a 66.1% increase since 2006 (Table 3-73).

Table 3-73. 2006–2009 Total Taxable Value of all Property (Locally Assessed), Duchesne County, Utah.

	2006 Actual	2007 Actual	2008 Actual	2009 Actual
Total Taxable Value	$6,760,277	$7,886,102	$9,450,343	$11,025,941
Percent Change Year to Year		16.5%	19.8%	16.7%
Percent Change Trend 2001-2006	66.1%			

Source: Utah State Tax Commission 2006, 2007, 2008, 2009

Centrally Assessed Taxes

The Utah State Tax Commission, Property Tax Division assesses the property value of mines, utilities, airlines, and motor and rail carriers. Mining, and gas and oil company property is physically valued to arrive at fair market value. Active mines, and oil and gas wells are assessed by estimating future cash flows and discounting the present value. The total taxable value of all centrally assessed property in Duchesne County in 2006 totaled $7,006,097, a 50.3% increase since 2006 (Table 3-74).

Table 3-74. 2006–2009 Total Taxable Value of all Property (Centrally Assessed), Duchesne County, Utah.

	2006 Actual	2007 Actual	2008 Actual	2009 Actual
Total Taxable Value	$4,661,937	$6,456,748	$6,218,027	$7,006,097
Percent Change Year to Year	N/A	38.5%	-3.7%	12.7%
Percent Change Trend 2001-2006	50.3%			

Source: Utah State Tax Commission 2006

Payments in Lieu of Taxes

In 1976, Congress directed federal land management agencies to allocate income to states and counties with federal lands, to provide a PILT program to help offset lost tax revenues. The BLM administers the PILT program.

In 2010, the federal government owns and manages roughly 67% of the land in Utah (Trust for Public Lands 2010). Federal lands are not subject to property taxes that support county governments and education, though local communities play an important role in supporting the management of federal lands. Utah receives the third largest amount of PILT; the state received just over $33 million in PILT during 2009 (the federal fiscal year) (Table 3-75). Between 2005 and 2009, Utah‘s allocation of PILT has fluctuated between $19–33 million. This fluctuation is due to a variety of factors; however, in general as the population and other federal land payments increase or decrease, the PILT will also fluctuate.

Table 3-75. Total PILT Payments and Total Acreage.

Location	2005	2006	2007	2008	2009	% Increase 2005–2009
Utah Payment	$19,622,224	$20,055,933	$20,057,363	$32,207,048	$33,063,034	68.5%
Utah Area (Acres)	32,826,575	32,819,718	32,825,820	32,841,547	32,824,203	
Duchesne County Payment	$789,960	$805,558	$803,141	$1,345,138	$1,383,884	75.18%
Duchesne County Area (Acres)	892,691	892,677	893,172	896,617	893,172	

Source: Demographic and Economic Analysis 2000; U.S. Department of the Interior 2010.

Secure Rural Schools and Community Self Determination Act

On October 3, 2008, the Secure Rural Schools and Community Self-Determination Act of 2000 was reauthorized as part of Public Law 110-343. The Act can be another source of

income to counties. While PILT payments offset lost revenue due to large tracts of federal land, the Secure Rural Schools Act provides revenues to counties to be used by local resource advisory committees to fund projects to maintain infrastructure, improve the health of watersheds and ecosystems, protect communities, and strengthen local economies. Utah received $15.2 million from Secure Rural Schools Forest Service payments in 2008. Duchesne County received 6% of these payments (Table 3-76).

Table 3-76. Total Secure Rural Schools Payments in 2008.

Location	2008
Utah Payment	$15,210,421
Duchesne County Payment	$880,484

Source: Forest Service 2008b.

Sales and Use Tax

Since 1997, the state‘s sales and use tax rate is 4.75%, and applies to the retail sales of meals, admission to recreation/amusement places, intrastate communication and passenger service, gas and heat utility service, commercial electric, hotel and motel accommodations, and certain other services. Duchesne County and the city of Duchesne also impose a 1.0% local sales tax, as well as a 0.25% County Option Sales Tax for a total rate of 6.00%. Roosevelt imposes an additional 0.10% Municipal Botanical, Cultural, Zoo Tax, as well as 0.25% for Highway Tax, totaling 6.35% for the community of Roosevelt (Utah State Tax Commission 2006).

Overall, there has been a significant increase between 2005 and 2009 in Sales and Use Tax collection at the county, and municipal levels. Roosevelt has seen the most substantial increase in that time period, and has experienced a 83.1% increase (Table 3-77). However, Utah has experienced an overall decrease of 5.3% between 2005 and 2009.

Table 3-77. Sales and Use Taxes Collected, Fiscal Years 2005–2009.

Location	2005	2006	2007	2008	2009	% Increase 2005–2009
Utah	$1,634,522,084	$1,806,264,423	$1,857,813,410	$1,739,384,630	$1,547,472,747	-5.3%
Duchesne County	$975,870	$1,117,610	$1,345,604	$1,417,355	$1,555,490	59.4%
Duchesne	$197,855	$236,126	$301,423	$294,859	$298,450	50.8%
Roosevelt	$966,271	$1,255,486	$1,460,272	1,569,395	1,769,423	83.1%

Source: Utah State Tax Commission 2006.

Severance Taxes

A severance tax is an excise tax imposed on the present and continuing privilege of removing, extracting, severing, or producing any mineral, or oil and gas in Utah. Severance taxes are intended to compensate present and future citizens of the state for that loss. Utah collected an estimated $77 million in severance taxes in 2009. Severance tax revenue averaged an annual $21 million between 1996 and 2000, contributing nearly 1.5% of the general fund. The following five years saw the contribution double to over $40 million annually, contributing 2.5% of the general fund (Pace 2006).

In Utah, the Mining Severance Tax is 2.6% of the taxable value of metals or metal-yielding mineral and varies depending on the mineral. The Mining Severance Tax applies to companies or individuals that extract gold, silver, copper, and other metalliferous minerals (Utah State Tax Commission 2006). The Oil and Gas Severance Tax applies to all owners of oil, gas, and natural gas liquids and is based on the value of oil and gas produced at the well, or liquids saved, sold, or transported from the field where it is produced. The tax rate is on a sliding scale, based on the sales price of the oil, gas, or natural gas, and ranges from 3% to 5%.

Federal and Mineral Lease Royalties

A mineral royalty is the amount of money the owner of the mineral resource receives as a payment or royalty from the mineral producer. Fifty percent of federal mineral royalties are returned to the state, and a portion of that is then distributed to counties and cities. In 1999, Utah received $31.4 million from mineral lease royalties and bonuses. Unlike severance taxes, royalties are based on the value of production and byproducts. Federal royalties are distributed by the State of Utah and are used to fund roads, public education, higher education, water and geological research, and other public services, particularly in areas that are impacted by natural resource development.

While federal land payments comprise only a small portion of total state revenues (mineral lease revenues comprised 0.87% of total state revenues in 1999), they do represent a sizeable contribution to many county governments (Table 3-78).

Table 3-78. Mineral Lease and Royalty Payment to Utah (dollars in thousands), 1995–1999.

Location	1995	1996	1997	1998	1999	% Increase 1995–1999
Utah Payment	$29,054	$34,719	$34,111	$33,485	$31,452	8.25%

Source: Utah State Tax Commission 2006

Transient Room Tax

Cities, towns, and counties, by voter approval, may impose a county Transient Room Tax of up to 3% on all sleeping accommodations, such as hotel and motel rooms, campgrounds, or similar public accommodations, for guests staying less than 30 days. The Transient Room Tax is applied in addition to the applicable sales tax. Duchesne County is one of six counties in the state that collects its own Transient Room Tax; the State Tax Commission collects the Transient Room Tax for all other counties in the state. All counties in the state assess the maximum 3% tax.

The total county Transient Room Taxes collected across the state has increased since 2005. However, there was a substantial decrease in Duchesne County where there was a decrease of 99.8% (Table 3-79).

Table 3-79. 2005–2009 Transient Room Tax Revenue for Duchesne County.

Location	2005	2006	2007	2008	2009	% Change 2005–2009
Duchesne County	$30,133	$1,466	$540	$7,450	$48	-99.8%
State Totals	**$17,521,252**	**$18,105,021**	**$20,294,926**	**$28,652,137**	**$24,445,300**	**39.5%**

Source: Utah State Tax Commission 2009

3.16.1.5 Environmental Justice

EO 12898 (February 11, 1994) and its accompanying memorandum have the primary purpose of ensuring that ~~"e~~ach federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations." To meet this goal, EO 12898 required that each agency develop an agency-wide environmental justice strategy.

The Presidential Memorandum that accompanied EO 12898 calls for a variety of actions. Four specific actions were directed at NEPA–related activities, including the following.

1. Each federal agency must analyze environmental effects (i.e., human health, economic, and social effects) of federal actions, including effects on minority communities and low-income communities, when such analysis is required by NEPA.
2. Mitigation measures outlined or analyzed in EAs, EISs, or RODs, whenever feasible, should address significant and adverse environmental effects of proposed federal actions on minority communities and low-income communities.
3. Each federal agency must provide opportunities for community input in the NEPA process, including identifying potential effects and mitigation measures in consultation with affected communities and improving accessibility of public meetings, official documents, and notices to affected communities.
4. In reviewing other agencies' proposed actions under Section 309 of the CAA, the EPA must ensure that the agencies have fully analyzed environmental effects on minority communities and low-income communities, including human health, social, and economic effects.

Demographics

Based on guidance developed by the Council on Environmental Quality (1997b), minority communities that may be addressed in the scope of NEPA analysis are generally considered as follows.

1. Minority—Individual(s) classified by Office of Management and Budget Directive No. 15 as Black/African American, Hispanic, Asian and Pacific Islander, American Indian, Eskimo, Aleut, and other non-white persons.
2. Minority Population—Minority populations should be identified where either:
   - the minority population of the affected area exceeds 50%; or
   - the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis.

Table 3-80 summarizes relevant data regarding minority populations for the study area in 2010. About 11% of the Duchesne County population is minority, compared with 13.9% for the state of Utah. The city of Duchesne has a minority population of 5.7%, and the city of Roosevelt is at 17.7%. Using the percentage of Duchesne County's minority population as a reference for the general population, the City of Roosevelt meets the criteria for an

environmental justice community in terms of minority population; 17.7% of the population is considered a minority, compared to 10.8% for Duchesne County.

Poverty

Based on guidance developed by the Council on Environmental Quality (1997b), low-income communities that may be addressed in the scope of NEPA analysis are generally considered as follows:

1. a low-income population exists where either the low-income population of the affected area exceeds 50 percent; or
2. the low-income population percentage of the affected area is meaningfully greater than the low-income population percentage in the general population or other appropriate unit of geographic analysis.

Low-income populations in an affected area are populations below the annual, statistical poverty thresholds from the U.S. Census Bureau‘s current population reports on income and poverty. Families and persons are classified by the U.S. Census Bureau as ―below poverty level” if their total family income or unrelated individual income is less than the poverty threshold specified for the applicable family size, age of householder, and number of related children under 18 that are present. Poverty status is determined for all families (and, by implication, all family members). For persons not in families, poverty status is determined by their income in relation to the appropriate poverty threshold. Thus, two unrelated individuals living together may not have the same poverty status.

Table 3-81 identifies persons below poverty level by county, and provides a comparison of those figures with the state level. According to the U.S. Census Bureau American Community Survey 5-year estimates, 2005-2009, approximately 10.3% of the Duchesne County population lived below the federal poverty level in 2009, compared with 10.4% for Utah. In the city of Duchesne, the poverty level was at 19.1% and Roosevelt was lower at 11.0%

Table 3-80. Minority Populations in the Study Area, 2010

Location	Race															
	Caucasian		African American		American Indian		Asian		Native Hawaiian or Pacific Islander		Other Race		Hispanic Origin (of any race)		Caucasian, Not of Hispanic Origin	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Utah	2,379,560	86.1%	29,287	1.2%	32,927	1.2%	55,285	2.0%	24,554	0.9%	166,754	6.0%	358,340	13.0%	2,221,719	80.4%
Duchesne County	16,589	89.2%	44	0.2%	842	4.5%	52	0.3%	51	0.3%	491	2.9%	1,117	6.0%	16,211	87.1%
City of Duchesne	1,594	94.3%	7	0.4%	20	1.2%	4	0.2%	4	0.2%	40	2.4%	74	4.4%	1,567	92.7%
City of Roosevelt	4,977	82.3%	20	0.3%	493	8.2%	28	0.5%	21	0.3%	229	3.8%	555	9.2%	4,798	79.4%

Sources: U.S. Census Bureau 2010a, 2010b, 2010d, 2010e

Table 3-81. Environmental Justice Statistics for the Study Area, 2009

Location	Persons below Poverty Level	Families below Poverty
Utah	2275,789(10.4%)	45,071 (7.2%)
Duchesne County	1,682 (10.3%)	395 (8.3%)
City of Duchesne	355 (19.1%)	104 (20.9%)
City of Roosevelt	708 (14.6%)	153 (11.0%)

Source: U.S. Census Bureau, American Community Survey; 2009a, 2009b, 2009c, 2009d.

Using the percentage of Duchesne County's low-income (below poverty level) population as a reference for the general population, the cities of Roosevelt and Duchesne meet the criteria for environmental justice communities in terms of low-income populations. The low-income populations of both cities exceeds 10.3% of individuals and 8.3% of families for Duchesne County.

Environmental Justice Communities

In summary, the cities of Duchesne and Roosevelt meet the criteria of environmental justice communities. The city of Roosevelt is considered both a minority and low-income community; the city of Duchesne is considered a low-income community.

3.16.2 Environmental Consequences

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 and employment of Uintah and Duchesne counties, and the demand for social services in these areas. Social impacts are often discussed qualitatively because quantitative data often are not available to address these impacts. To the extent possible, economic impacts are quantified based on assumptions and estimates of employment, production, and revenue.

3.16.2.1 Impacts Common to All Alternatives

The following impacts are common across all action alternatives.

- 95% of drillers live full-time in the Uintah Basin, in Duchesne and Uintah counties. Of these drillers, approximately one-half live in Duchesne County and the other half in Uintah County. Transfer of workforce from other job sites to the Project Area would be minimal.
- School capacity in the region is sufficient to meet current needs. Increases in population of school-age children would impact local schools.
- Water availability is sufficient for the current population; the system can serve up to 12,000 people; currently, about one-half of that capacity is being used.
- Additional law enforcement and fire response personnel may be required throughout the area, depending on where workers locate and the extent of population and employment increases.

- Additional expenditures by the Operator include collection of additional sales and use tax for the state, counties, and communities. Estimated severance taxes, ad valorem production and property taxes, federal mineral royalties, and PILT taxes and Secure Rural Schools payments, would accrue to the federal, state, and local governments.

3.16.2.2 Alternative 1 – No Action Alternative

Population and Demographics

Under the No Action Alternative, it is expected that overall population fluctuations would remain consistent with local trends. No new employment would result from this alternative, thus, no impact to population or demographics would be expected.

Economic Sectors and Employment

Under the No Action Alternative, no additional employment would be generated if no well-field development occurs. As such, impacts to economic sectors and employment would be negligible.

Quality of Life

Under the No Action Alternative, no impact to quality of life would be expected. No additional well-field development would occur; thus no economic activity from development would occur. Production would be limited to existing, currently producing wells. The least amount of economic change would be expected compared to the Proposed Action and Alternatives 3 and 4.

Under this alternative, there would be no additional demands on housing, no increase in population, or proportional increase in crime as a result of this oil and gas project. There would be no large-scale conversion of large tracts of land for gas development as in the Proposed Action (see Alternative 2 discussion). As such, amenities including natural beauty and undeveloped, relatively isolated open space would remain without the well pad and associated facilities development.

Housing prices in the state and in Duchesne County increased between 2000 and 2010. As discussed in Section 3.16.1.5.1 (–Housing”), housing prices would likely continue to decrease, as they have over the past five years in Duchesne and Roosevelt, until the local and national markets rebound; the number of vacant units would increased between 2000 and 2010; there are no other known projects or industries expected in the region that might increase housing occupancy. The crime rate in the county increased 38.2% between 2000 and 2005; however, there was a 47.73% decrease in Roosevelt in the same period. Larceny and burglary represented the largest number of crimes in the area. Because there would be no population increase under this alternative, the crime rate would likely continue at its current pace.

Public Facilities and Services

Because no additional well-field development would occur, no additional pressures on public facilities and services would be expected, other than marginal increases consistent with current conditions and historic trends. Thus, no impact to public facilities and services would be expected.

Taxes and Revenues

Under the No Action Alternative, no economic activity from oil field development would occur. No additional ad valorem, conservation, sales, etc. tax revenue would be generated for the region. Thus, no impact to taxes and revenues would be expected.

Development, Processing, and Gathering Costs

Because no additional well-field development would occur, there would be no additional short- or long-term development, processing, or gathering costs associated with this alternative. Thus, no impact to development, processing, and gathering costs would be expected.

Environmental Justice

Under the No Action Alternative no additional impacts to the two environmental justice communities (cities of Duchesne and Roosevelt) would be expected beyond current conditions.

3.16.2.3 Alternative 2 – Proposed Action

Population and Demographics

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. When compared to other oil and gas development operations in the vicinity, however, growth attributed to the Proposed Action would be relatively minor. 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 LOP, with the highest increases in population occurring during the initial construction phase. Many oil and 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.

Economic Sectors and Employment

Projected employment by alternative was calculated using information provided by the Operator. It is anticipated that each well would require 22 workers during drilling phases, 20 for completion, and 6 per workover crew[1]. Using estimated worker hours for each phase, an estimate of total employment per year can be calculated. It is expected that workers will likely continue employment throughout the LOP, thus maintaining a steady rate of employment over time. In addition to rig crews, 24 pumpers, two foremen, one mechanic, one roustabout, one trainer, and one well analysis technician would be hired as full-time Operator employees. The need for these individuals would likely last through the LOP. Table 3-82 gives an estimate of projected employment by alternative during drilling and completion phases. Additional crew numbers have been included in the employment discussion.

[1] Workover crews work on a workover rig; the workover rig is used on an as needed basis, on a producing well to try to increase production.

Table 3-82. Projected Employment During Drilling and Completion Phases.

Employment by Alternative				
Worker Type	**Annual Hours per Well**	**Total Worker Hours per Year**	**Worker Hours LOP**	**Estimated Workers per Year[1]**
Alternative 2 (Assumed 50 wells drilled per year)				
Rig Crew	1,848	92,400	739,200	21
Completion Crew	1,440	72,000	576,000	16
Workover Crew	72	3,600	28,800	1
Production	122	6,100	48,800	1
Total	**3,482**	**174,100**	**1,392,800**	**39**
Alternative 3 (Assumed 50 wells drilled per year)				
Rig Crew	1,848	92,400	739,200	21
Completion Crew	1,440	72,000	576,000	16
Workover Crew	72	3,600	28,800	1
Production	122	6,100	48,800	1
Total	**3,482**	**174,100**	**1,392,800**	**39**
Alternative 4 (Assumed 40 wells drilled per year)				
Rig Crew	1,848	73,920	739,200	17
Completion Crew	1,440	57,600	576,000	13
Workover Crew	72	2,880	28,800	1
Production	122	4,880	48,800	1
Total	**3,482**	**139,280**	**1,392,800**	**32**

[1] Assumes maximum wells drilled per year.

Thus, the Proposed Action would likely contribute to an impact on quality of life in terms of increased economic activity, both directly from the Proposed Action and indirectly from associated increases in regional spending (i.e., construction, food services, lodging, etc).

Employment

Under the Proposed Action, the overall number of jobs available in the region would be expected to increase as a result of the drilling of proposed wells. The Proposed Action would employ approximately 40 individuals annually with 31 additional full-time employees. The Operator also anticipates that a total of 45 other contractors, water haulers, and roustabouts would be required for maintenance of the field, bringing the total potential new employment to 116. This number would remain relatively consistent through the LOP, as the number of wells drilled on an annual basis would remain constant under this alternative.

In addition, jobs in the mining, construction, and services industry (i.e., food services and lodging) would also increase. In large part, initial well construction attracts 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. 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 within other employment sectors and by new workers who move to the area.

Income

Under the Proposed Action, the Operator anticipates that wages for completion workers would average $25 per hour, which includes average wage plus overtime pay. Highly skilled workers would likely make much more on an hourly basis than general laborers. Rig crew workers would average $32 per hour, pumpers $20 per hour, and a foreman approximately $80,000 per year. Income levels would be higher than the county averages. Thus, the Proposed Action would likely contribute to a positive economic impact for potential workers.

Quality of Living

Quality of life could be impacted by oil and gas development and production in the region under the Proposed Action. An increase in population and employment would result in attendant increases in housing needs and crime. The short-term impacts (one to two years) to local communities and other local jurisdictions could be positive as increased population from the gas development workforce helps occupy the estimated 34.8% housing vacancy rate in Duchesne County. Increased economic activity could enhance the availability of goods and services, as well as cultural, educational, and recreational opportunities. However, the conversion of large tracts of land to gas development is seen by some as industrialization and a diminishment of the characteristics they value in the region: natural beauty and quiet, vast reaches of unpopulated and undeveloped open space, fresh air, and wildlife.

Public Facilities and Services

A population increase could be accompanied by a proportional increase in crime, fire, and demands on community resources. Since the Proposed Action proposes 100% more new wells than the No Action Alternative, it would place proportionately more demands on the community infrastructure. Potential beneficial effects would include increased local economic activity and reduced poverty, and the potential for improved public facilities and services once ad valorem taxes, severance taxes, and other revenues become available to the local counties and communities.

Because of the population increase anticipated as a result of new oil and gas development and production jobs, the project could potentially result in an increase in the crime rate for Duchesne County and Roosevelt. Additional law enforcement personnel may be required to serve the increasing population base related to the Proposed Action.

Thus, the Proposed Action would likely contribute to a positive impact on public facilities and services in terms of increased economic activity and improvements funded by potential tax revenue; however, the Proposed Action could result in a negative impact on public facilities and services in terms of increasing pressures on community infrastructure and services.

Taxes and Revenues

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. The project would generate revenues for state, county, and local governments, as well as area school districts, through state sales tax, federal income tax, ad valorem taxes, severance taxes, federal minerals royalties, and other taxes on facilities and production. Expenditures include intergovernmental, education, transportation, health, police, fire, and corrections (UEO 2004). Table 3-83 summarizes potential anticipated revenues and expenditures for the Uintah Basin area, on a general, per well basis based on 2008 oil and gas prices.

Table 3-83. Revenue and Expenditures per Well for Uintah Basin.

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

The UEO assumes a 100-well-per-year drilling and completion project (using 2004 dollars).

According to the Operator, statistical analysis revealed the range of estimate ultimate recovery (EUR) to be from a high of 82 thousand stock tank barrels (mstb) to a low of 5 mstb. One quarter of the wells have EUR in the range of 20 to 30 mstb. Table 3-84 shows the average EUR and most frequent interval for wells completed in a given year.

Table 3-84. Average EUR and Most Frequent Interval.

Completion Year	Average EUR, Mstb	Frequent Interval, Mstb
1998	25	
2001	61	60–70
2002	32	
2003	33	30–40
2004	40	20–30
2005	25	10–20
2006	14	10–20

Based on Table 3-85 and a total of 400 wells2 proposed under this alternative, net local revenue over the LOP would total $11,280,000, or an annual average of $205,091, into the Duchesne County economy. Table 3-86 illustrates the potential net local revenue by alternative.

[2] Socioeconomic analysis was performed based on the original 400 proposed wells for the Proposed Action and other action alternatives.

Table 3-85. Potential Additional Revenue by Alternative (Using 2004 Dollars).

	Alternative 1 (No Action)	Alternative 2 (Proposed Action)	Alternative 3	Alternative 4
Number of Wells	0	400	400	400
Life of Project (Years)	0	55	55	55
Average Annual Local Revenue	$0	$205,091	$205,091	$205,091
Local Revenue (million)*	$0	$11,280,000	$11,280,000	$11,280,000

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

Increases in taxes and revenues would provide counties and communities with more discretionary dollars to develop infrastructure and support the population. However, short-term budgetary impacts to local governments would occur due to population growth and its effects on housing and local infrastructure, services, and facilities. Receipt of taxes generally lags one year behind production; therefore, affected counties and communities would not receive funds until two years after drilling activities begin. Over the LOP, Duchesne County and communities in the study area would benefit from increased revenues from ad valorem/centrally assessed (property) taxes, as shown in Table 3-86. Some federal and mineral lease royalties, conservation, and severance taxes would also be distributed (Table 3-87) to the counties and communities, based on a state distribution formula. Other tax revenues generated, but not included in the table, would include sales and use and transient room taxes. These amounts have not been estimated, even though they will represent an increase in local revenues throughout the region.

Under the Proposed Action, estimated revenue over the LOP, from royalty, conservation, and severance taxes, totals approximately $60.6 million (see Table 3-87).

Ad valorem taxes on property were estimated for this analysis as $2,500 per well, paid to the County; under the Proposed Action this tax revenue could be substantial and amount to approximately $935,000 over the LOP, or an approximate average of $17,000 per year. The majority of revenue would be generated through royalty payments amounting to 89.5% of total revenue, followed by severance tax at 16.5%, and conservation tax at 1.0%.

Table 3-86. Estimated Ad Valorem Tax Revenue to the State by Alternative over the Life of the Project (using 2004 dollars)

	Alternative 1 (No Action)	Alternative 2 (Proposed Action)	Alternative 3	Alternative 4
Number of Wells	0	400	400	400
Life of Project (LOP) (Years)	0	55	55	55
Average Annual Ad valorem tax	$0	$17,000	$17,000	$18,182
Total LOP Ad valorem tax	$0	$935,000	$935,000	$1,000,000

*This assumes $2,500 per well in ad valorem (property taxes)

Table 3-87. Estimated Royalty, Severance, and Conservation Tax Revenue to the State by Alternative, over the Life of the Project.

	Alternative 1 (No Action)	Alternative 2 (Proposed Action)	Alternative 3	Alternative 4	(Action Alternatives) Percent of Total
Number of Wells	0	400	400	400	
Royalties	$0	$50,000,000	$50,000,000	$50,000,000	82.5%
Severance Tax	$0	$10,000,000	$10,000,000	$10,000,000	16.5%
Conservation Tax	$0	$600,000	$600,000	$600,000	1.0%
Total		**$60,600,000**	**$60,600,000**	**$60,600,000**	

In addition, real property values are likely to change as population fluctuates within the study area. Housing costs in the cities of Duchesne and Roosevelt decreased between 2000 and 2005 (7.68% and 7.65%, respectively); with the potential for increased demand for housing in the region, housing costs would likely increase proportionally with demand, rather than continue to decrease. Population growth would also stimulate additional commercial and residential activity, but indirect property taxes generated by this activity are beyond the scope of this analysis and are not addressed further.

Overall, the Proposed Action would contribute to a positive impact on taxes and revenues in terms of increased tax revenues.

Development, Processing and Gathering Costs

Well-cost estimates for the Proposed Action are based on price structure, mechanics, and completion techniques in 2008 dollars. Drilling costs include surveys, permits, fees, location and roads, drilling contractor services and equipment, rentals, casing crews, contract labor and supervision, drilling water, drilling overhead, and transportation and hauling. Completion costs include completion rig and auxiliary services, snubbing unit, contract supervision, professional services, casing crews, pumping services, transportation and hauling, location and roads, completion water, rentals and installation labor.

The cost to develop a single well pad and well to a depth of approximately 6,000 feet below the surface is estimated at $945,000; for processing and gathering there is an initial $20,000 investment, with $6,000 per year for gathering system maintenance, gas processing such as liquids removal, and compression (Table 3-88). Therefore, the total estimated development, processing, and gathering cost over the LOP, would be $1,295,000 per well under the Proposed Action; if all 400 wells are drilled, this amounts to $518 million (Table 3-89).

Table 3-88. Per Well Pad Cost for Development, Processing, and Gathering.

Activity	Cost per Well Pad
Development	
Pad and road construction	$35,000
Drilling cost	$365,000
Completion Cost	$410,000
Production equipment installation	$135,000
Development Total	**$945,000**
Processing and Gathering	
Initial investment	$20,000
Annual Cost	$6,000
LOP Cost (55 years)*	$350,000
Total Development, Processing, Gather Cost (per well)	**$1,295,000**

*LOP for the Proposed Action and Alternative 3.

Table 3-89. Total Life of Project Cost, by Alternative.

	Alternative 1 (No Action)	Alternative 2 (Proposed Action)	Alternative 3	Alternative 4
Number of Wells (LOP)	0	400	400	400
Total LOP Cost	$0	$518,000,000	$518,000,000	$518,000,000

*Using $1.29 million per well as outlined in Table 3-88.

Environmental Justice

Under Executive Order 12898, when determining whether human health effects are disproportionately high and adverse, agencies must consider the following three factors to the extent practicable.

- Whether the health effects, which may be measured in risks and rates, are significant, unacceptable, or above generally accepted norms (adverse health effects may include bodily impairment, infirmity, illness, or death).
- Whether the risk or rate of hazard exposure by a minority population or low-income population to an environmental hazard is significant and appreciably exceeds or is likely to appreciably exceed the risk or rate to the general population or other appropriate comparison group.
- Whether health effects occur in a minority or low-income population affected by cumulative or multiple adverse exposures from environmental hazards.

Similarly, when determining whether environmental effects are disproportionately high and adverse, agencies are to consider the following three factors to the extent practicable.

- Whether there is or would be an impact to the natural or physical environment that significantly and adversely affects a minority population, low-income population, or Indian tribe. Such effects may include ecological, cultural, human health, economic, or social impacts on minority communities, low-income communities, or Indian tribes when those impacts are interrelated to impacts on the natural or physical environment.
- Whether environmental effects are significant and are or may have an adverse impact to minority populations, low-income populations, or Indian tribes that appreciably exceeds or is likely to appreciably exceed those on the general population or other appropriate comparison group.
- Whether the environmental effects occur or would occur in a minority population, low-income population, or Indian tribe affected by cumulative or multiple adverse exposures from environmental hazards.

It is assumed that minority populations in the area would have the same opportunities in obtaining new jobs available from the Proposed Action, therefore resulting in no disproportionate impacts. However, disproportionate adverse impacts to low-income populations, specifically the cities of Duchesne and Roosevelt, could result from increased housing costs brought about by the current "boom" the area is experiencing, making it more difficult for them to afford adequate housing. Increases in the availability of jobs that pay above county averages would likely have beneficial impacts to low-income communities in the Project Area. Other than the disproportionate impacts to the low-income cities of Duchesne and Roosevelt in terms of housing costs, the Proposed Action would not result in any other major adverse impacts to the natural or physical environment.

In terms of human health risks, as discussed in Section 3.2.2 (Air Quality, Environmental Impacts), there would be a negligible risk to public health and safety from the proposed project. Thus, no disproportionate impacts to environmental justice communities in terms of human health are expected under the proposed action.

In summary, the Proposed Action could result in disproportionate impacts to the low-income communities of Duchesne and Roosevelt in terms of housing costs. No other disproportionate impacts, either to the physical or natural environment, or to human health, are anticipated.

3.16.2.4 Alternative 3

Impacts to socioeconomics under Alternative 3 would be expected to be the same as those discussed for the Proposed Action with the exception of those discussed below. Both alternatives would include the same maximum number of drilled wells (400) over the same time period (55 years). Both short- and long-term impacts would be similar to those described for the Proposed Action.

Development, Processing, and Gathering Costs

Because Alternative 3 proposes the same amount of wells as the Proposed Action, it would result in the same development, processing, and gathering costs per well. However, additional costs could be incurred as a result of the mitigation measures that would be

required under Alternative 3, such as POD components and application of BMPs such as centralized production facilities, etc.

3.16.2.5 Alternative 4

Population and Demographics

Under Alternative 4, it is expected that impacts to population and demographics would be similar to those discussed in the Proposed Action, as employment needs would remain relatively consistent over the LOP. Both alternatives would include the same maximum number of drilled wells (400), though fewer wells per year would be drilled, resulting in seven less workers per year needed for Alternative 4 (see Table 3-82). Both short- and long-term impacts would be similar to those described for the Proposed Action.

Economic Sectors and Employment

Additionally, the same number of wells would be drilled over the LOP, although only 40 wells per year would be drilled under Alternative 4 (compared to 50 wells per year under the Proposed Action), resulting in 18,480 less worker hours per year. Additionally, 32 workers per year are anticipated; this is seven less workers per year than under Alternatives 2 and 3. Therefore, the annual work force demand would be lower, however the total workforce demand over the LOP would be the same as the other action alternatives.

Like the Proposed Action, under Alternative 4, 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. Alternative 4 would employ approximately 32 workers annually, which is seven fewer workers and 18,480 hours less than the Proposed Action (see Table 3-82). This number would remain relatively consistent through the LOP, as the number of wells drilled on an annual basis (n = 40) would remain constant under this alternative. Impacts to income levels of workers in the area would be similar to those experienced under the Proposed Action.

Quality of Living

Under Alternative 4, there would be less demand for a workforce than under the Proposed Action, however, the reduced demand is marginal. All action alternatives would require a workforce for 400 wells. Therefore, there would be an increase in population and employment, with an attendant increase in housing needs and crime; however, both the short-term and long-term impacts would be similar to the Proposed Action.

Public Facilities and Services

A minor population increase could be accompanied by a proportional increase in crime, fire, and demands on community resources. Demands on community infrastructure, as well as the potential beneficial effects, such as increased local economic activity and reduced poverty, and the potential for improved public facilities and services, would be similar to those discussed under the Proposed Action.

Taxes and Revenues

A total of 400 wells is proposed under Alternative 4; net local revenue over the LOP would total $1 million, or an annual average of $18,182, into the Duchesne County

economy (see Table 3-85). Estimated revenue from royalty, conservation and severance taxes, over the LOP would total approximately $60.6 million under Alternative 4.

Development, Processing and Gathering Costs

Based on Tables 3-88 and 3-89, the total estimated costs over the LOP would be $1,295,000 per well, as in the Proposed Action and Alternative 3; if all 400 wells are drilled, the total LOP cost for development, processing, and gathering would be the same as the Proposed Action.

Environmental Justice

Under Alternative 4, it is likely that impacts to environmental justice populations within the Project Area would be similar to those experienced under the Proposed Action.

3.16.3 Cumulative Impacts

Population and Demographics

Because Duchesne and Uintah counties have resource-based economies, current and foreseeable oil and gas development would contribute to population growth in the region. 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 surrounding the Project Area.

Employment and Income

As population proportionally increases with the number of oil and gas wells drilled, increased employment opportunities would be experienced throughout the LOP for the Proposed Action and varying alternatives. It is likely that the resulting decrease in unemployment would have cumulative beneficial effects to the local economy by reducing poverty and improving overall quality of life in the region.

Quality of Living

Quality of life could be cumulatively impacted by oil and gas development and production in the area. Population in Duchesne and Uintah counties is anticipated to increase as a result of increased employment opportunities and needs generated both directly and indirectly by the project. Likely beneficial effects include increased affluence and reduced poverty, an increase in the number and possible quality of health care providers, and improved schools and other tax-supported services and amenities (e.g., libraries, streets, and parks). While the Proposed Action would be unlikely to result in significant increases in population from increased employment directly related to the project, the Proposed Action in combination with other oil and gas projects, plus the general growth in economic activity associated with these projects, may attract individuals to the area and result in cultural changes. For those who value the intimacy, security, and pace of small towns, population growth with its attendant increases in traffic, crowding, pressure on housing availability and costs, noise, crime, and the presence of strangers may be considered a lowering of the quality of life.

Crime may increase in the study area if the population grows directly or indirectly as a result of the Proposed Action or Alternatives 3 and 4. New residents without roots in the

community, without social connections, and with a limited choice of leisure activities may contribute to additional unlawful behavior. An influx of job seekers attracted by the increased level of development in the area but who fail to find jobs could also result in increased crime.

Public Facilities and Services, Taxes and Revenues

Increases in ad valorem taxes for Duchesne County, which is divided between the county general fund, local school district, the state school fund, and several other local funds, would result in increased revenues and be a beneficial impact to the school systems. The tax base increase would allow for the purchase of higher-quality teaching materials and potentially increasing the wages of teachers, which could attract teachers with better credentials than would otherwise seek positions within the study area. Additionally, increased funding would provide schools with more options to improve education and the overall quality of the workforce in the study area.

3.17 Short-term Uses and Long-term Productivity

NEPA requires consideration of ~~"th~~e relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity" (40 CFR 1502.16). As declared by Congress in section 101 of the NEPA of 1969, this includes using all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans.

3.17.1 Air Quality

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 LOP.

3.17.2 Geology and Minerals

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.

3.17.3 Paleontology

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. Paleontological resources that are exposed and properly recovered, as a result of this project, would provide additional opportunities for scientific studies and long-term benefits to the resource.

3.17.4 Soils

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.

3.17.5 Water Resources

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 LOP.

3.17.6 Vegetation

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. A period of 75 to 100 years may be required for reestablishment of mature pinyon-juniper woodlands.

3.17.7 Wildlife

Construction of roads, well pads, and pipelines would provide a short-term use that would result in long-term loss and fragmentation of wildlife habitat. Indirect effects from project activities would also have long-term negative impacts on the habitat suitability and productivity of wildlife species in the Project Area. These impacts would decrease, but would not eliminate, the long-term productivity of the wildlife habitat in the Project Area.

3.17.8 Special Status Species

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 ORVs, sedimentation, and wildfire would also have long-term negative impacts on the habitat suitability of special status species in the Project Area.

3.17.9 Livestock Grazing

Activities associated with the proposed oil and gas well development (e.g., roads, grading, and 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.

3.17.10 Cultural Resources

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

3.17.11 Recreation

The short-term use of the Project Area for oil and gas development would not impact long-term productivity of recreational resources since reclamation would restore the recreational values of the land.

3.17.12 Potential Wilderness and Inventoried Roadless Areas

Implementation of the Proposed Action or action alternatives would provide a short-term mineral use that would eventually result in long-term loss of attributes that define potential wilderness and IRA. Long-term impacts to potential wilderness areas would be the result of altering existing wilderness attribute conditions such as solitude (from noise and an altered visual setting), fragmentation of existing continuous blocks of 5,000 acres or more, and the overall manipulation of the natural ecological processes depending on alternative. Long-term impacts would be especially noticeable for the Nutters Canyon Potential Wilderness Area as this area would not be eligible for identification as potential wilderness in any future potential wilderness inventories. Impacts in the other Potential Wilderness and IRAs would persist until oil and gas operations cease and surface disturbance and vegetation losses are successfully reclaimed.

3.17.13 Transportation

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 related to support of this project, over the LOP, or until project roads were decommissioned. Although increased traffic volume from drilling and construction would occur for up to 20 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 LOP.

3.17.14 Visual Resources

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 LOP, 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 Forest Service VRM objectives.

3.17.15 Socioeconomics

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.

3.18 Unavoidable Adverse Effects

Unavoidable adverse effects are those effects that cannot be avoided due to constraints in alternatives. These effects do not have to be avoided by the planning agency, but they must be disclosed, discussed, and mitigated, if possible.

3.18.1 Air Quality

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

3.18.2 Geology and Minerals

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.

3.18.3 Paleontology

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.

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 ensure 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.

3.18.4 Soils

Unavoidable adverse impacts 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.

3.18.5 Water Resources

Unavoidable adverse impacts from the Proposed Action and action alternatives include long-term decreases in available groundwater and surface water resources due to consumptive use. In surface waters, increased salinity would likely occur due to on-going project activities that result in surface disturbance (whether initial or ongoing). Unavoidable adverse impacts to wetlands and riparian areas include reduced function as a result of indirect disturbance by roads, pipelines, and well pads in floodplains.

3.18.6 Vegetation

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.

3.18.7 Wildlife

The following adverse 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.

3.18.8 Special Status Species

Adverse impacts to special status species 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 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.

3.18.9 Livestock Grazing

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.

3.18.10 Cultural Resources

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

3.18.11 Recreation

Unavoidable adverse impacts to recreational resources include the long-term loss of primitive and unconfined recreational opportunities from surface-disturbing activities; increased vehicle traffic; and adverse visual impacts. Other unavoidable adverse impacts apply to specific groups of forest visitors such as hunters, who would be impacted indirectly by direct impacts to big-game herds in the area. In areas of concentrated oil and gas development, change in natural settings is an unavoidable long-term adverse impact to recreational resources.

3.18.12 Potential Wilderness and Inventoried Roadless Areas

Unavoidable adverse effects to potential wilderness and IRAs include the loss of attributes such as undeveloped character, and opportunities for solitude or primitive recreation. These losses would occur as a result of the presence and visibility of oil rigs, increased traffic volume, noise, and temporary loss of vegetation and fragmentation.

3.18.13 Transportation

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.

3.18.14 Visual Resources

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.

The proposed well developments fall within areas assigned a Modification Visual Quality Objective, where developments may dominate the landscape, but must borrow from line, form, texture, and color natural to the area. While developments would deviate from the existing natural appearance, they will meet the VQO of Modification due to mitigations derived from site specific analysis. 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.

3.18.15 Socioeconomics

Given that natural resource development is finite and based on demand, the Uintah 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.

3.19 Irreversible and Irretrievable Commitments of Resources

Irreversible commitments of resources are those that cannot be regained, such as the extinction of a species or the removal of mined ore. Irreversible commitments apply primarily to nonrenewable resources, such as cultural resources, and also to those resources that are renewable only over long periods of time, such as soil productivity or forest health. Irretrievable commitments are those that are lost for a period of time such as the temporary loss of timber productivity in forested areas that are kept clear for use as a power line rights-of-way or road. Irretrievable commitments generally apply to loss of production, harvest, or use of natural resources.

3.19.1 Air Quality

There would be no irreversible impacts to air quality. Air quality would be irretrievably degraded in and around the Project Area for the LOP.

3.19.2 Geology and Minerals

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 oil and natural gas that is extracted from the Project Area would be removed irreversibly for future extraction.

3.19.3 Paleontology

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.

3.19.4 Soils

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.

3.19.5 Water Resources

Under the Proposed Action and alternatives, irretrievable commitments of resources would be limited to loss of riparian vegetation and decreased proper functioning condition and loss or alteration of floodplain function during the LOP. The functional value of these resources would be irretrievably lost until restoration is completed. All other impacts to water resources, wetlands and riparian areas, and floodplains would be neither irretrievable nor irreversible.

3.19.6 Vegetation

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.

3.19.7 Wildlife

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.

3.19.8 Special Status Species

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.

3.19.9 Livestock Grazing

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.

3.19.10 Cultural Resources

The implementation of laws that protect cultural resources would provide for mitigation of impacts from permitted activities. However, the development of up to 400 wells throughout the Project Area would likely impact a large number of sites. Depending on the actual number of NRHP eligible sites that are impacted, it may make mitigation

through full data recovery an impractical solution for each and every resource and a sampling strategy for data recovery may be required. Loss of sites that are not included in any sampling strategy will result in an irreversible loss of data. In addition, for sites that are excavated, even though data would be recovered through scientific research, excavation and subsequent destruction through well field construction activities will result in an irreversible commitment of resources.

Several irretrievable commitments of resources would also occur. During the active lifetime of the well field (and potentially even after if the access roads are not removed), there would be a period of time where cultural resources not otherwise impacted by direct well field development effects would be under increased threat of looting, vandalism, and destruction. In addition there may be periods of time during which cultural resources within the Project Area would not be available to Native Americans for traditional uses, or to scholars for research purposes. Since these effects would last for the life of the well field and until any reclamation and restoration actions have been completed, but are potentially reversible, they would be irretrievable rather than irreversible.

3.19.11 Recreation

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).

3.19.12 Potential Wilderness and Inventoried Roadless Areas

Long-term impacts to wilderness attributes would be irretrievable until successful reclamation at the completion of natural gas development restored any lost or altered attributes. Irreversible impacts would include the alteration of any of the previously identified wilderness attributes where long-term development (i.e., roads) occurs and cannot be reclaimed (due to continued use or poor reclamation potential). In addition, irreversible impacts to the Nutters Canyon Potential Wilderness Area include this area‘s ineligibility to be mapped as potential wilderness in any future potential wilderness inventories.

3.19.13 Transportation

Surface disturbance by the project would remain in that state until rehabilitated, as described elsewhere in this chapter.

3.19.14 Visual Resources

There would be no irreversible impacts expected for aesthetic (visual) resources as a result of the Proposed Action for those areas of surface disturbances that can be reclaimed; well pads can be capped and buried; pipelines can be removed; and access roads can be closed and reclaimed. However for those areas where use would be continued or where full reclamation cannot be achieved there may be an irreversible lose to visual resources. There would be a long-term irretrievable loss of scenic quality during the 50-year project lifetime from the presence of the oil and gas wells and infrastructure until these structures were removed and/or the disturbed areas were reclaimed.

3.19.15 Socioeconomics

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

CHAPTER 4.0 CONSULTATION AND COORDINATION

4.1 Preparers and Contributors

This EIS was prepared by the USDA Forest Service in Vernal, Utah. A third-party contractor assisted the Forest Service to conduct studies, gather data, and prepare documents. Tables 4-1 and 4-2 list the individuals and federal, state, and local agencies that helped prepare this analysis. Section 4.1.2 includes names of tribes; and non-Forest Service persons with which the Forest Service included in the scoping efforts for the development of this EIS.

4.1.1 Interdisciplinary Team Members

Table 4-1. Forest Service and Cooperating Agencies Interdisciplinary Team EIS Preparers.

Name	Responsibility
David Herron	Project Lead/Geology/Paleontology
Kristy Groves	District Ranger
Mike Elson	Deputy District Ranger
Sherry Fountain	BLM Liaison
Kathy Paulin	SO NEPA/Forest Planning
Bob Christensen	District Wildlife
Ron Brunson	District Fisheries
Allen Huber	District Range
Kim Bartel	District Recreation
Mark Muir	SO Hydrology/Water
Chris Plunkett	SO Hydrology/Water
Kris Rutledge	SO NEPA
Peter Kempenich	SO Lands
Shauna Debyshire	SO Lands
Helen Kempenich	SO Air Quality
Jeff Sorkin	Region 2 Regional Office Air Quality Manager
Valton Mortenson	SO Engineer
Clay Johnson	SO Heritage/Archaeology
Jeff Rust	SO Heritage/Archaeology
Anita DeZort	SO Recreation
Darlene Koerner	SO Soils

Name	Responsibility
Mark Duffy	SO GIS Data
Jonathan Jemming	State of Utah Public Lands/RDCC

Table 4-2. Consultant Interdisciplinary Team EIS Preparers.

Name	Responsibility
SWCA Environmental Consultants	
Adrian Hogel	Project Manager/Vegetation/Range
Shawn Childs	NEPA Oversight/Oil and Gas Expertise
Matt Petersen	Principal-in-Charge
Jon Kehmeier	QA/QC Oversight/Soils/Water Resources
Cynthia Manseau	Technical Editor
Kristen Kennedy	Administrative Assistant/Administrative Record
Chris Haas	Wildlife Biologist
Heather Stettler	Cultural Resources Principal Investigator
Chuck Bollong	Archaeologist
Paul Murphey	Paleontology
Cara Bellavia	Socioeconomics
David Harris	Visual/Recreation/Transportation
Catherine Smith	GIS Coordinator
ENVIRON	
Sue Kemball-Cook	Air Quality
Ralph Morris	Air Quality
New Mexico Tech	
Martha Cather	RFDS/Geology

4.1.2 Federal, State, and Local Agencies

The following federal, state, and local agencies participated in scoping or were contacted for this EIS.

Central Utah Water Conservancy

Craig Chamber of Commerce

Daggett County Commission

Daggett County Courthouse

Duchesne County Economic Development

Duchesne County Commissioners

Duchesne County Water Conservation District

Duchesne County Weed Control

Environmental Protection Agency, Region 8

Manila Town Council

Mayor of Rock Springs

Office of Congressman Jim Matheson

Office of Federal Land Policy

Rock Springs Chamber of Commerce

State of Utah Department of Commerse and Economic Development

State of Utah Division of Water Rights

State of Utah Trust Lands Administration

Summit County Commissioners

Sweetwater County Commissioners

Sweetwater County Sheriff

Town of Tabiona

U.S. Army Corps of Engineers - Sacramento District

U.S. Army Corps of Engineers Colorado/Gunnison Basin Office

Uintah County Commissioner

Uintah County Conservancy District

Uintah County Library

Uintah County Sheriff

Uintah County/Vernal City Economic Development

Uintah Water Conservancy District

U.S. Fish and Wildlife Service Utah Field Office

USDA Forest Service Caribou National Forest

USDA Forest Service Fishlake Naitional Forest

USDA Forest Service Jeff Sorkin, Air Quality Specialist

USDA Forest Service Manti-LaSal National Forest

USDA Forest Service Uinta-Wasatch-Cache National Forest

USDA NRCS

USDA-APHIS-Wildlife Services

USDI Bureau of Indian Affairs

USDI Bureau of Land Management

USDI Bureau of Reclamation

USDI National Park Service

U.S. Fish and Wildlife Service

Utah County Commissioners

Utah Department of Natural Resources

Utah Department of Transportation

Utah Division of Forestry, Fire, State Lands

Utah Division of Drinking Water

Utah Division of Parks and Recreation

Utah Division of Water Quality

Utah Division of Wildlife Resources

Utah Division of Water Resources

Utah Division of Wildlife Resources

Utah Public Lands Policy Office

Utah Regulatory Office

Utah State Historic Preservation Office

Utah State Representative Gordon E. Snow

Utah State University Extension

Vernal City

Wasatch County Commissioners

Weber Basin Water Cons. Dist.

Wyoming Business Council

Wyoming Department of Transportation

Wyoming Game and Fish Green River Field Office

Wyoming Legislature

Wyoming State Historic Preservation Office

4.1.3 Tribes

The following Native American tribes were included in the scoping efforts for this EIS.

Northern Ute Indian Tribe

Ute Indian Tribe Business Committee

Ute Indian Tribe Fish/Wildlife

Ute Indian Tribe Natural Resources Division

Ute Tribe Environmental Coordinator

4.1.4 Others

The following names were identified as interested individuals for this project and were included in the scoping efforts for this EIS.

A. J. Franesen

Adkins & Christiansen P.C.

Adrian K. & Ellen B. Reynolds

Albert Neff

Allen Bob Lindsay

Alma T. Richins

American Rivers

Ashley Creek

Ashley Valley Water & Sewer

Ashley Valley Water Users

Ayres and Baker Pole and Post Inc.

B&D RV Center

B. Sachau

Backcountry Horsemen of America

Bat Conservation International

Bear Track Outfitters

Bill James

BIO/West Inc.

Biodiversity Associates

Bjork, Lindley, Little, P.C.

Blacks Quarter Horses

Blazzard Lumber Company Inc.

Brent Hansen

Buddy Russell

Burlington Resources

Carl Allen Morck

Carla Boucher

Casper Star Tribune

Cedar Springs Marina

Central Utah Project Completion Act Office

Chris Proctor

Clark Timber Products

Clark Tucker

Clay Hamann

Clifford & Lenora Smith

Cody Huseby

Cody Jenkins

Collette Mountain Resort Inc.

Colton Ranch Inc.

Craig Axford

Craig Calder

Craig or Rosalyn Thomas

Croman Corp.

Crystal A. Hackett

Danny Baker

Darreld L. & Naomi Shepard

Darryl and Ellen Sorensen

Dave Palmer
David Bentley
David C. Kirby
Defas Dude Ranch
Dinaland Snowmobile Club
Dinosaur Expeditions
Dinosaur Nature Association
Dinosaurland Resource Conservation and Development
Dinosaurland Travel Board
Doug Eatough
Douglas Nielsen
Dwight Merkley
Earl C. Dallon
EPG, Inc.
Eugene Dee Jenson
Flaming Gorge KOA Campground
Flaming Gorge Lodge
Flaming Gorge Recreation Services
Floyd Bartlett
Forest Guardians
Foundation of North American Sheep
Frank Meek
Frontiers of Freedom/People for
Garth Baxter
Gary Drage
Gene Smith
Gillette & T. Ferguson
Glen Iorg
Grasslands Consulting Inc.
Green Logging Inc.
Green River Outfitter Guide Association
Green River Outfitters
Greendale Cooperative Drainage
Henry Remund
High Uintas Preservation
High Uintas Preservation Council
Honorable Barbara Cubin
Honorable Christopher Cannon
Honorable Jim Geringer
Honorable Jim Matheson
Honorable Michael B. Enzi
Honorable Orrin G. Hatch
Honorable Robert Bennett
Independent Petroleum Assc. of MT
Intermountain Resources, LLC
Ivan Hall
J.R. Broadbent
J/L Ranch
Jack Lytle
James W. Thompson
Jan Ellen Burton
Janet Howard
JC Brewer
Jeffery D. & Linda Horrocks
Jensen Welcome Center
Jerome and Kathlyn Brady
Jimmy Brotherson
Joan C. Reid
Joe & Carol Shields
John Busch
John Conley
John Holderegger
John Maupin
John Swanson
John Tinker
Kay Madsen
Kirby Walker
KNEU/KIFX

KSL-TV CHANNEL 5
Larry Shelton
Larson's Sawmill
Laurie Stone
Leavitt Lumber Company
Lee Roy Brinegar
Leland N Sowards Fam Ptn
Lenita Steinaker
Linda Hacking
Lorin Merkley
Lyle Taylor
Lyman Grazing Association
Lynn and Cheryl Burton
Marc Bingham
Mark Mackiewicz
Max Ericksen
Max Haslem
Melvin Jay & Korey J. Abbott
Mike Meehan
Milton Hollander
Moon Lake Electric Association
Moon Lake Resort
Moon Lake Water Users
Myke Hall
Nature Watch
Nolen Giles
North Fork Water Users
Painter & Co. Inc.
Parsons Behle & Latimer
People for the West
Phillip & Robin Brady
Public Lands Committee
Public Lands Info Center REI
Quarter Circle E Ranch
Quarter Circle JR Ranch
R. Kent Angus
Radio Station KVEL 920 AM
Ralph Cooley
Randy Nielsen
Raymond Pallesen
Real Estate Division LDS Church
Red Canyon Lodge
Reed's Motor & Marine
Richard Hardinger
Richard McDowell
Robert & Renee Park
Robert Kay
Robert Nebeker
Rock Springs Chamber of Commerce
Rocking C Ranch
Rocky Mountain Elk Foundation
Rod Weaver
Rodney Nielsen
Roger's Radiator
Roy & Brenda Sorensen
S.J. & Jessie E. Quinney
Sageriders
Salt Lake County Fish & Game Assoc.
Salt Lake Tribune
Sheep Creek Irrigation Co.
Sheila Fenn
Sierra Club-Ogden Group
Simper Lumber Inc.
Simplot Phosphates
Smiling Lake Consulting
Smith Lumber Company
Snowmobile/ATV Club
South and Jones Timber Company Inc.

Sports Guide
Steve Sweat
Stoltze Aspen Mills
Strawberry River Livestock Inc.
Sweetwater Television Corp.
The Nature Conservancy
The Sierra Club
Theodore Roosevelt Cons Partnership
TriCounty Health Department
Trout Creek Flies
Trout Unlimited
UBAOG
UEC
UELS Inc.
Uintah Basin Sportsmen
Uintah Mountain Club
Urroz Ranch
UT Snowmobile Assoc.
Utah Cattlemen's Assn.
Utah Reclamation Mitigation
Utah Rural Development Council
Utah Shared Access Alliance
Utah Wildlife Federation
UWCD
Vernal Express Publishing Company
Vicky Lane
Vince Desimone
Wade Stevens
Wasatch Wave
Wendell W. Wild
Western Land Exchange Project
Western Land Realty Inc.
Western Native Trout Campaign
Western Resource Advocates
Western Watersheds Project, Inc.
Western Wood Products
Williams Gas Pipelines West
WRR Industries Inc.
Wyoming Outdoor Council
Wyoming Stock Growers Assoc.
York Motorsports

4.2 Distribution of the Environmental Impact Statement

This environmental impact statement has been distributed to individuals who specifically requested a copy of the document. In addition, copies have been sent to the following Federal agencies, federally recognized tribes, state and local governments, and organizations.

Berry Petroleum
Central Utah Water Conservancy District
EPA, Office of Federal Activities
EPA, Region 8, NEPA Program
State of Utah, Division of Air Quality
USDA Forest Service, Ashley National Forest, Duchesne/Roosevelt Ranger District
USDA Forest Service, Rocky Mountain Region, Air Program
USDA National Agricultural Library

USDI BLM, Vernal Field Office

USDI, Office of Environmental Policy and Compliance

Utah Environmental Congress

Ute Indian Tribe, Air Quality Program

CHAPTER 5.0 REFERENCES

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GLOSSARY

abandon: To cease producing oil or gas from a well when it becomes unprofitable. Usually, some of the casing is removed and salvaged, and on or more cement plugs are placed in the borehole to prevent migration of fluids between formations.

acre-foot or acre-feet: The volume of water that covers a one-acre area at a depth of one foot (43,560 cubic feet or 325,851 gallons).

administrative record: a collection of hard-copy material that documents the NEPA process and analysis.

aeolian: Refers to landforms shaped by wind or sediments transported and deposited by wind.

affected environment: The resource values potentially affected by the Proposed Action and alternatives analyzed in a NEPA document.

air quality: The properties and degree of purity of air to which humans, and natural and cultural resources are exposed.

air quality model: Air quality models use mathematical and numerical techniques to simulate the physical and chemical processes that affect air pollutants as they disperse and react in the atmosphere. Based on inputs of meteorological data and source information like emission rates and stack height, these models are designed to characterize primary pollutants that are emitted directly into the atmosphere and, in some cases, secondary pollutants that are formed as a result of complex chemical reactions within the atmosphere.

algal: Of, pertaining to, or composed of algae.

allotment: An area of land where one or more permittees graze their livestock. Generally consists of public land but may include parcels of private or state lands. The number of livestock and season of use are stipulated for each allotment. An allotment may consist of one or several pastures.

alluvium: Clay, silt, sand, and gravel or other rock material transported by flowing water and deposited as sorted or semi-sorted sediments.

Alternative: A substitute for a lead agency‘s Proposed Action that accomplishes the action in another manner.

ancillary facilities: Facilities often required in an oil and gas field other than the wells and pipelines (e.g., compressor stations).

animal unit months (AUMs): The amount of forage necessary to sustain one cow/calf pair for 1 month.

Annual Average Daily Traffic (AADT): the total volume of vehicle traffic in both directions of a highway or road for a year divided by 365 days.

Antiquities Act of 1906: This Act authorizes the President to declare federal lands as national monuments for the purpose of protecting sites and objects of antiquity.

anticline: An area of rock deformation characterized by a downward slope to either side. In an exposed anticline, the oldest rock layers are in the center and the rocks on either side dip or slope away from the center of the structure. If covered by an impermeable layer of rock, an anticline is a potential oil or gas reservoir.

Application for Permit to Drill (APD): The Department of Interior application permit form to authorize oil and gas drilling activities on federal land or mineral estate.

aquifer: A water-bearing bed or layer of permeable rock, sand, or gravel capable of yielding water.

archaeological: The scientific studies of ancient peoples and cultures by analysis of physical remains (artifacts).

Archaeological Resource Protection Act of 1979: This purpose of this act is to protect archaeological resources and sites which are on public lands and Indian lands, and to foster increased cooperation and exchange of information between governmental authorities, the professional archaeological community, and private individuals.

Area of Critical Environmental Concern (ACEC): An area on public lands designated for special management to protect important historic, or scenic values; fish and wildlife resources; other natural systems or processes; or human life and safety.

arterial roads: A moderate or high-capacity road which is immediately below a highway level of service.

Authorized Officer (AO): The Forest Service or BLM employee delegated the authority to perform specific duties.

badlands: Steep or very steep, commonly non-stony barren lands dissected by many intermittent drainage channels. Badlands are most common in semi-arid and arid regions where streams are entrenched in soft geologic material. Runoff potential is very high, and geologic erosion is active in such areas.

Bald Eagle Protection Act of 1940: This law provides for the protection of the bald eagle (the national emblem) and the golden eagle by prohibiting, except under certain specified conditions, the taking, possession and commerce of such birds.

berm: A raised area with vertical or sloping sides.

Best Management Practices (BMPs): Structural, nonstructural, and managerial techniques that are recognized to be the most effective and practical means to prevent or minimize environmental impacts, yet are still compatible with the productive use of the resource to which they are applied.

big game: Large animals that are hunted or fished for sport.

biological crust: The community of organisms living at the surface of desert soils. Major components are cyanobacteria, green algae, microfungi, mosses, liverworts and lichens.

Bureau of Land Management (BLM): An agency within the United States Department of the Interior which administers America's public lands, totaling approximately 264 million acres.

Bureau of Land Management's Onshore Oil and Gas Orders: Onshore Oil and Gas Orders implement and supplement the oil and gas regulations found at 43 CFR 3160 for conducting oil and gas operations on Federal and Indian lands.

butte: An isolated hill with steep, often vertical sides and a small flat top, smaller than mesas and plateaus.

calcareous: Containing calcium carbonate.

carbon monoxide (CO): A colorless, odorless, and tasteless gas. It consists of one carbon atom covalently bonded to one oxygen atom.

casing: Steel pipe placed in an oil or gas well to prevent the hole from collapsing.

Categorical Exclusion: A category of actions which do not individually or cumulatively have a significant effect on the human environment and for which, therefore, neither an environmental assessment nor an environmental impact statement is required.

cementing: The process by which cement is used to "set" casing in the well bore and to seal off unproductive formations and apertures.

Clean Water Act of 1972: This act employs a variety of regulatory and non-regulatory tools to sharply reduce direct pollutant discharges into waterways, finance municipal wastewater treatment facilities, and manage polluted runoff.

colluvium: A general term applied to loose and incoherent deposits, usually located at the foot of a slope or cliff and typically brought there by forces of gravity.

commercial well: A well capable of producing profitably.

completion: The activities and methods to prepare a well for production. Includes installation of equipment for production from an oil and gas well.

compressor station: A facility in which the pressure of natural gas is raised to facilitate its transmission through pipelines.

condensate (gas condensate): Hydrocarbons (oil) contained in the natural gas stream, often removed by condensation.

conditions of approval (COAs): A set of restrictions, or conditions, included in the approval of a federal permit, including NEPA documents.

conglomerate: Rounded water-worn fragments of rock or pebbles cemented together by another mineral substance.

Council on Environmental Quality (CEQ): An advisory council to the President established by the National Environmental Policy Act of 1969. It reviews federal programs for their effect on the environment, conducts environmental studies, and advises the President on environmental matters.

Cretaceous Period: The most recent period of the Mesozoic Era, between 136 and 65 million years ago.

critical elements of the human environment: A list of resource concerns that must be addressed in every NEPA document.

crucial ranges: Any particular seasonal range or habitat component that has been documented as the determining factor in a population's ability to maintain itself at a certain level over the long-term.

cryptobiotic soils: A biological soil crust composed of living cyanobacteria, green algae, brown algae, fungi, lichens, and/or mosses. Commonly found in arid regions around the world, cryptobiotic soils are important members of desert ecosystems and contribute to the well being of other plants by stabilizing sand and dirt, promoting moisture retention, and fixing atmospheric nitrogen.

cubic feet per second (cfs): The rate of discharge representing a volume of 1 cubic foot of water passing a given point during 1 second.

cultural resources: The physical remains of human activity (artifacts, ruins, burial mounds, petroglyphs, etc.) and the conceptual content or context (as a setting for legendary, historic, or prehistoric events, such as a sacred area of native peoples, etc.) of an area of prehistoric or historic occupation.

cumulative impact: The impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taken place over a period of time (40 CFR 1508.7).

cut and fill: A construction process whereby the amount of earth cut from cuttings roughly matches the amount of fill needed to make nearby embankments, so minimizing the amount of construction labor.

demographics: The study of, or information about, people's lifestyles, habits, population movements, spending, age, social grade, employment, etc.

directional drilling: The intentional deviation of a wellbore from vertical to reach subsurface areas off the one side from the surface drilling site.

discharge: The volume of water flowing past a point per unit time, commonly expressed as cubic feet per second (cfs), gallons per minute (gpm), or million gallons per day (mgd).

dispersion: The spreading out of pollutants. Generally used to show the extent to which an air pollutant will spread from a particular point.

displacement: As applied to wildlife, forced shifts in the patterns of wildlife use, either in location or timing of use.

disposal well: A well into which produced water from other wells is injected into an underground formation for disposal.

disruptive activities: Those authorized Public Land resource uses/activities that are likely to alter the behavior, displace, or cause excessive stress to existing animal or human populations occurring at a specific location and/or time. This term does not apply to the physical disturbance of the land surface, vegetation, or features.

dissolved solids: The total amount of dissolved material, organic and inorganic, contained in water or wastes.

diversity: The distribution and abundance of different plant and animal communities and species.

drainage: Natural channel through which water flows at least part of the year.

dredged or fill materials: Material that is excavated or dredged from waters of the United States or material placed in waters of the United States where the material has the effect of (i) replacing any portion of a water of the United States with dry land; or (ii) changing the bottom elevation of any portion of a water of the United States.

drill rig: The mast, draw works, and attendant surface equipment of a drilling unit.

drilling fluid: Fluid used to lubricate and cool the drill bit, to assist in lifting cuttings from the borehole, and to control pressures in the borehole.

drought: Prolonged dry weather (precipitation less than 75% of average annual amount).

ecosystem: An interacting system of organisms considered together with their environment (e.g., forest, marsh, and stream ecosystems).

emergent vegetation: Erect, rooted, herbaceous plants that project out of or emerge from the water.

endangered species: A species that is in danger of extinction and whose survival is unlikely if the causal factors continue. Section 3 of the Endangered Species Act of 1973 defines ―endangered species" as any species that is in danger of extinction throughout all or a significant portion of its range.

Endangered Species Act of 1973: This act provides for the conservation of ecosystems upon which threatened and endangered species of fish, wildlife, and plants depend. It authorizes the determination and listing of species as endangered and threatened, prohibits unauthorized taking, possession, sale, and transport of endangered species, provides authority to acquire land for the conservation of listed species, using land and water conservation funds, authorizes establishment of cooperative agreements and grants-in-aid to states that establish and maintain active and adequate programs for endangered and threatened wildlife and plants, authorizes the assessment of civil and criminal penalties for violating the Act or regulations, and authorizes the payment of rewards to anyone furnishing information leading to arrest and conviction for any violation of the Act or any regulation issued thereunder.

endemic: Natural to or characteristic of a specific people or place; native; indigenous.

Energy Policy Act of 2005: A bill passed by the 109th Congress in August 2005 that includes new authority (Section 388) for Minerals Management Service to regulate alternate energy resources on the outer continental shelf.

environment: The aggregate of physical, biological, economic, and social factors affecting organisms in an area.

Environmental Assessment (EA): An environmental analysis prepared pursuant to the National Environmental Policy Act to determine whether a federal action would significantly affect the environment and thus require a more detailed environmental impact statement.

Environmental Impact Statement (EIS): An analysis of alternative actions and their predicable environmental impacts, including physical, biological, economic, and social consequences and their interactions; short- and long-term impacts; and direct, indirect, and cumulative impacts.

environmental justice: Equal protection from environmental hazards for individuals, groups, or communities regardless of race, ethnicity, or economic status. This applies to the development, implementation, and enforcement of environmental laws, regulations, and policies, and implies that no population of people should be forced to shoulder a disproportionate share of negative environmental impacts of pollution or environmental hazard due to a lack of political or economic strength levels.

Eocene: The second epoch of the Cenozoic Era; the start of the Eocene is marked by the emergence of the first modern mammals.

ephemeral drainage: A drainage area or a stream that has no base flow. Water flows for a short time each year but only in direct response to rainfall or snowmelt events.

erosion: The removal, detachment, and entrainment of earth materials by weathering, dissolution, abrasion, and corrosion, later to be transported by moving water, wind, gravity, or glaciers.

evaporitic: Sediments that are deposited from aqueous solution as a result of extensive or total evaporation of the solvent.

Executive Order (EO): A directive issued by the President, the head of the executive branch of the federal government.

exploratory well: A well that is drilled to evaluate the gas or oil resources that may be present.

fault: A fracture in bedrock along which there has been vertical and/or horizontal movement caused by differential forces in the earth‘s crust.

federal lands: All lands and interests in lands owned by the U.S. that are subject to the mineral leasing laws, including mineral resources or mineral estates reserved to the U.S. in the conveyance of a surface or non-mineral estate.

federally listed species: A plant or animal species that is placed on the Federal list of endangered and threatened wildlife and plants and receives protection under the Endangered Species Act.

Federal Land Policy and Management Act (FLPMA): The act that (1) set out for the Bureau of Land Management standards for managing the public lands, including land use planning, sales, withdrawals, acquisitions, and exchanges; (2) authorized the setting up of local advisory councils representing major citizens groups interested in land use planning and management, (3) established criteria for review of proposed wilderness areas; and (3) provided guidelines for other aspects of public land management such as grazing.

Federal Noxious Weed Act of 1974: Public Law 93-629 (7 U.S.C. 2801 et seq.; 88 Stat. 2148), enacted January 3, 1975, established a Federal program to control the spread of noxious weeds. The Secretary of Agriculture was given the authority to designate plants as noxious weeds by regulation, and the movement of all such weeds in interstate or foreign commerce was prohibited except under permit. The Secretary was also given authority to inspect, seize and destroy products, and to quarantine areas, if necessary to prevent the spread of such weeds. He was also authorized to cooperate with other Federal, State and local agencies, farmers associations and private individuals in measures to control, eradicate, or prevent or retard the spread of such weeds.

Federal Register: A daily bulletin published by the U.S. Government that provides a record of federal actions.

Fish and Wildlife Coordination Act: Act enacted to protect fish and wildlife when federal actions result in the control or modification of a natural stream or body of water. The statute requires federal agencies to take into consideration the effect that water-related projects would have on fish and wildlife resources; take action to prevent loss or damage to these resources; and provide for the development and improvement of these resources.

floodplains: The portion of a river valley, adjacent to the channel, that is built of recently deposited sediments and is covered with water when the river overflows its banks at flood stages.

fluvial: Of or pertaining to rivers.

forage: Vegetation of all forms available for animal consumption.

forb: A broad-leafed flowering herb other than grass.

Forest Service sensitive species: Plant and animal species identified by a Regional Forester for which population viability is a concern, as evidenced by significant current or predicted downward trends in population numbers or density and habitat capability that would reduce a species‘ existing distribution. Management of sensitive species must not result in a loss of species viability or create significant trends toward federal listing.

formation: A body of earth material with distinctive and characteristic physical properties. A formation may be made of rock or of unconsolidated material such as sand, gravel and clay and can be mapped on the earth‘s surface or traced in the subsurface.

gas reservoir: The ―pool” of oil or gas that is being trapped.

gathering pipeline: Pipelines within a field that transport gas or oil from the well to a central production facility or to the point of sale.

Global Positioning System (GPS): Computer software that records and stores coordinates for positions on earth via satellite.

grazing: The use of grasses and other plants to feed wild or domestic herbivores such as deer, sheep and cows.

groundwater: Water contained in the pore spaces of consolidated and unconsolidated material.

gullying: Formation of ditches or hollows worn by running water.

habitat: A specific set of physical conditions that surround a single-species, a group of species, or a large community. In wildlife management, the major components of habitat are considered to be food, water, cover, and living space.

habitat function: The arrangement of habitat features and capability of those features to sustain species, population, and diversity of wildlife over time.

halogeton: A coarse annual herb introduced into North America from Siberia; dangerous to sheep and cattle on western rangelands because of its high oxalate content.

herbaceous: Herblike, non-woody plant.

historic preservation: A process to protect buildings with historic value or significance from destruction or extensive renovation.

Horsepower (HP): A unit for measuring the rate of mechanical energy output. The term is usually applied to engines or electric motors to describe maximum output. 1 hp = 745.7 Watts = 0.746 kW = 2,545 Btu/hr.

human environment: The factors that include, but are not limited to, biological, physical, social, economic, cultural, and aesthetic factors that interrelate to form the environment.

hydric soil: Soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part.

hydrocarbon: A compound formed from carbon and hydrogen (e.g., oil and gas).

hydrologic indicators: Evidence of wetland hydrology, such as standing or flowing water, saturated soil, water marks, or drift lines.

hydrology: A science that deals with properties, distribution, and circulation of surface and subsurface water.

hydrophytic vegetation: Plant community dominated by hydrophytes; plants that may occur in wetlands.

hydrostatic testing: Testing of the integrity of a newly placed but uncovered pipeline for leaks. The pipeline is filled with water and pressurized to operating pressures, and the pipeline is visually inspected.

impacts: Impacts include ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic, social, or health, whether direct, indirect, or cumulative. Direct impacts are caused by the action and occur at the same time and place; indirect impacts are caused by the action but occur later in time or are farther removed in distance.

infrastructure: The basic framework or underlying foundation of a community, including road networks, electric and gas distribution, water and sanitation services, and facilities.

interdisciplinary team (IDT): A group of federal and cooperating agencies selected to work within the NEPA process in scoping, analysis, and document preparation. The purpose of the team is to integrate its collective knowledge of the physical, biological, economic, and social sciences and the environmental design arts into the environmental analysis process. Interaction among team members often provides insight that otherwise would not be apparent.

interim reclamation: Reclamation initiated on well pads, roads, and pipelines after drilling activity is completed and wells are in production. Interim reclamation is considered successful when reclamation performance objectives are met.

intermittent stream: A stream or reach of a stream that is below the local water table for at least some part of the year and obtains its flow from both surface runoff and groundwater discharge.

invasive species: A plant or animal species that has moved into an area and reproduced so aggressively that it has replaced some of the original (native) species.

lacustrine cycle: A series of rises and falls of water levels preserved in sedimentary layers showing periods of dry and wet conditions.

Land and Resource Management Plan (LRMP): A Forest Service planning document, prepared in accordance with Section 202 of the Federal Land Policy and Management Act, that presents systematic guidelines for making resource management decisions for a resource area. An RMP is based on an analysis of an areas's resources, their existing management, and their capability for alternative uses. RMPs are issue oriented and developed by an interdisciplinary team with public participation.

landslide: A perceptible downhill sliding or falling of a mass of soil and rock lubricated by moisture or snow.

Laramide orogeny: A period of mountain building in western North America, which started in the Late Cretaceous, 70 to 80 million years ago, and ended 35 to 55 million years ago.

lek: A traditional courtship display area attended by male greater sage-grouse in or adjacent to sagebrush-dominated habitat. Leks are categorized as:

> **Active -** Any lek that has been attended by male greater sage-grouse during the strutting season.

Inactive - Leks where it is known that there was no strutting activity through the course of a strutting season.

Unknown - Leks that have not been documented either active or inactive during the course of a strutting season.

Occupied - A lek that has been active during at least one strutting season within the last 10 years.

Unoccupied (formerly termed ―historical lek") - There are two types of unoccupied leks: (1) Destroyed - a formerly active lek site and surrounding sagebrush habitat that has been destroyed and is no longer capable of supporting greater sage-grouse breeding activity. (2) Abandoned - a lek in otherwise suitable habitat that has not been active during a consecutive 10-year period.

Undetermined - Any lek that has not been documented as being active in the last 10 years but that does not have sufficient documentation to be designated unoccupied.

life of project: Begins with the first disturbance authorized under the ROD for a project and ends when all wells are plugged and abandoned and all surface disturbance (each disturbed site) meets the reclamation performance objectives.

loam: A mixture of sand, silt, and clay containing between 7% and 27% clay, 28% to 50% silt, and less than 50% sand.

local roads: BLM roads that provide primary access to large blocks of land and connect with or are extensions of a public road system.

long-term impacts: For the purpose of this NEPA analysis, long-term impacts last for the life of the project or beyond.

macroinvertebrates: Large or exceptionally prominent animals that lack a spinal column.

Management Indicator Species (MIS): A representative group of species that are dependent on a specific habitat type. The health of these species are used to gauge the function of the habitat on which it depends and, in turn, the health of other dependent species.

Memorandum of Understanding: An official agreement establishing the principles that will guide the implementation of programs or projects.

mesa: An isolated, relatively flat-topped natural elevation, usually more extensive than a butte and less extensive than a plateau.

migration corridor: A tract of land that forms a passageway and facilitates the seasonal migration of animals.

migratory bird: Bird that moves seasonally from one region to another.

Migratory Bird Treaty Act of 1918: Act that implements various treaties and conventions between the U.S. and Canada, Japan, Mexico and the former Soviet Union for the protection of migratory birds. Under the Act, taking, killing or possessing migratory birds is unlawful.

Mineral Leasing Act of 1920: This Act authorizes and governs leasing of public lands for developing deposits of coal, phosphates, oil, gas and other hydrocarbons and sodium.

Mining and Mineral Policy Act of 1970: This Act declares that it is the continuing policy of the Federal Government to foster and encourage private enterprise in the development of a stable domestic minerals industry and the orderly and economic development of domestic mineral resources. This act includes all minerals, including sand and gravel, geothermal, coal, and oil and gas.

mitigation: Avoiding the impact altogether by not taking a certain action or parts of an action; minimizing impacts by limiting the degree of magnitude of the action and its implementation; rectifying the impact by repairing, rehabilitating, or restoring the affected environment; reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and/or compensating for the impact by replacing or providing substitute resources or environments.

mitigation measures: Actions taken to reduce or minimize potential impacts to the environment.

modeling: A mathematical or physical representation of an observable situation. In air pollution control, models afford the ability to predict pollutant distribution or dispersion from identified sources for specified weather conditions.

monitoring: To systematically and repeatedly watch, observe, or measure environmental conditions in order to track changes.

National Ambient Air Quality Standards (NAAQS): The allowable concentrations of air pollutants specified by the federal government. The air quality standards are divided into primary standards (based on the air quality criteria and allowing an adequate margin of safety and requisite to protect the public health) and secondary standards (based on the air quality criteria and allowing an adequate margin of safety and requisite to protect the public welfare from any unknown or expected adverse effects of air pollutants).

National Environmental Policy Act of 1969 (NEPA): The federal law established in 1969, which went into effect on January 1, 1970, that 1) established a national policy for the environment, 2) requires federal agencies to become aware of the environmental ramifications of their proposed actions, 3) requires full disclosure to the public of proposed federal actions and a mechanism for pubic input into the federal decision-making process, and 4) requires federal agencies to prepare an environmental impact statement for every major action that would significantly affect the quality of the human environment.

National Forest Management Act of 1976 (NFMA): Act that requires the Secretary of Agriculture to assess forest lands, develop a management program based on multiple-use, sustained-yield principles, and implement a resource management plan for each unit of the National Forest System. It is the primary statute governing the administration of national forests.

National Historic Preservation Act Section 106: A federal statute that established federal program to further the efforts of private agencies and individuals in preserving the Nation's historic and cultural foundations. NHPA authorized the establishing of the National Register of Historic Places, established the Advisory Council on Historic Preservation and a National Trust Fund to administer grants for historic preservation, and authorized the development of regulations to require federal agencies to consider the effects of federally assisted activities on properties included on or eligible for the National Register of Historic Places.

National Register of Historic Places (NRHP): The official list, established by the Historic Preservation Act of 1966, of the nation's cultural resources worthy of preservation. The National Register lists archaeological, historic, and architectural properties nominated for their local, state, or national significance by state and federal agencies and approved by the National Register Staff.

native species: Plants or animals that originated in the area in which they are found (i.e., they naturally occur in that area); with respect to a particular ecosystem, a species that, other than as a result of an introduction, historically occurred or currently occurs in that ecosystem.

natural gas: Those hydrocarbons, other than oil and other than natural gas liquids separated from natural gas, that occur naturally in the gaseous phase in the reservoir and are produced and recovered at the wellhead in gaseous form.

nitrogen oxide (NOx): A product of combustion from transportation and stationary sources and a major contributor to the formation of ozone in the troposphere and to acid rain.

No-action alternative: The management direction, activities, outputs, and effects that are likely to exist in the future if the current plan were to continue unchanged.

No Surface Occupancy (NSO): A stipulation in a lease that disallows any surface disturbance in the lease area at any time. Natural gas or oil from an NSO area, for instance, would have to be recovered by directional drilling.

Notice of Intent (NOI): A notice published in the *Federal Register* to announce the intent to prepare an EIS.

noxious weeds: Officially designated (State of Wyoming-designated, Sublette County-declared) undesirable or invading weedy species generally introduced into an area by humans.

oil and gas lease: A federal legal document that gives the lease holder the right to explore for and develop any oil and gas that may be present under the area designated in the lease while complying with any surface use conditions that may have been stipulated when the lease was issued.

Onshore Oil and Gas Order No. 7: Disposal of Produced Waters. This Order provides the methods and approvals necessary to dispose of produced water associated with oil and gas operations.

outcrop: A surface exposure of bare rock, not covered by soil or vegetation.

ozone: A molecule containing three oxygen atoms produced by passage of an electrical spark through air or oxygen (O_2).

paleontology: The science that deals with the history and evolution of life on earth.

perennial stream flow: A stream or reach of a stream that flows throughout the year.

permeable: The extent that a porous rock, sediment, or soil is able to transmit a liquid.

physiographic province: A region having a pattern of relief features or landforms that differs significantly from adjacent regions.

pinyon-juniper woodland: Significant vegetation type in the southwestern United States, dominated by *Pinus edulis* and *Juniperus monosperma*.

Plan of Development (POD): Documentation that identifies the scope of the project.

Preferred Alternative: The alternative identified in the EIS as the action favored by the lead agency.

Preservation of American Antiquities: An act passed by the United States Congress and signed into law by Theodore Roosevelt on June 8, 1906 giving the President of the United States authority to restrict the use of particular public land owned by the federal government by executive order, bypassing Congressional oversight.

prevention of significant deterioration (PSD): A classification system established to preserve, protect, and enhance the air quality in National Wilderness Preservation System areas in existence prior to August 1977 and other areas of national significance, while ensuring that economic growth can occur in a manner consistent with the preservation of existing clean air resources.

produced water: Water brought to the surface through the borehole.

production: Phase of commercial operation of an oil field.

production facilities: Tangible well and leased equipment comprising casing, tubing, wellheads, pumps, flowlines, oil and gas gathering systems, separators, treaters, dehydrators, lease and centralized tank batteries.

Proposed Action: The alternative identified in the EIS as the action favored by the project proponent.

public land: Lands or interests in lands owned by the United States and in this case administered by the Secretary of Interior through the Bureau of Land Management, without regard to how the United States acquired ownership.

pump jack: The overground drive for a reciprocating piston pump installed in a borehole. It is used to mechanically lift liquid out of the well if there is not enough bottom hole pressure for the liquid to flow all the way to the surface.

rangeland: Land on which the natural vegetation is made up primarily of native grasses, forbs, or shrubs valuable for forage and suitable for grazing livestock.

raptor: A group of carnivorous birds consisting of hawks, eagles, falcons, kites, vultures, and owls. A bird of prey.

rare plant: A plant that either lives in a very limited habitat or its habitat is threatened by humans. A rare plant species is either a) broadly distributed, but never abundant where found, b) narrowly distributed or clumped, and abundant where found, or c) narrowly distributed or clumped, and not abundant where found.

reclamation: Rehabilitation of a disturbed area to make it acceptable for designated uses. This normally involves regrading, replacement of topsoil, revegetation, and other work necessary to restore it for use.

Record of Decision (ROD): A decision document for an EIS or Supplemental EIS that publicly and officially discloses the responsible official‘s decision regarding the actions proposed in the EIS and their implementation.

Recreation Opportunity Spectrum (ROS): A framework for inventorying, planning, and managing the recreational experience and setting.

reserve pit: An excavated pit that may be lined with plastic that holds drill cuttings and waste mud.

Resource Conservation and Recovery Act (RCRA): Act that gives the U.S. Environmental Protection Agency (EPA) authority to control hazardous waste from the "cradle-to-grave." This includes permitting the generation, transportation, treatment, storage, and disposal of hazardous waste.

revegetation: The reestablishment and development of self-sustaining plant cover. On disturbed sites, human assistance will speed natural processes by seedbed preparation, reseeding, and mulching.

Right-of-way (ROW): The legal right for use, occupancy, or access across land or water areas for a specified purpose or purposes.

riparian: Land areas directly influenced by water that usually have visible vegetative or physical characteristics showing this water influence. Streamsides and lake borders are typical riparian areas.

roosting: Refers to avian slumber; a bird will typically use the same roost for an extended period of time.

royalty: The share of the minerals produced from a lease; a percentage of production either in money or in kind which a lessee is required to pay.

runoff: That part of precipitation that appears in surface streams. Precipitation that is not retained on the site where it falls and is not absorbed by the soil.

salinity: A measure of the concentration of dissolved salts in a given amount of water or body of water.

scatter (archeological): Archaeological evidence of prior disturbance that is distributed about an area rather than concentrated in a single location.

scoping: An early and open process for determining the scope of issues to be addressed in an EIS and for identifying the significant issues related to a proposed action. Scoping may involve public meetings, field interviews with representatives of agencies and interest groups, discussions with resource specialists and managers, and written comments in response to news releases, direct mailings, and articles about the proposed action and scoping meetings.

Section 7 of the Endangered Species Act of 1973 (as amended): Portion of the Act that requires Federal agencies to insure that any action authorized, funded or carried out by them is not likely to jeopardize the continued existence of listed species or modify their critical habitat.

Section 404 of the Clean Water Act of 1972: Portion of the Act that establishes a program to regulate the discharge of dredged or fill material into waters of the United States, including wetlands. Section 404 requires a permit before dredged or fill material may be discharged into waters of the United States, unless the activity is exempt from Section 404 regulation.

sediment: Soil or mineral transported by moving water, wind, gravity, or glaciers, and deposited in streams or other bodies of water or on land.

seismic: Pertaining to an earthquake or earth vibration, including those that are artificially induced.

sensitive soils: Soils having physical and/or chemical characteristics that could inhibit or limit successful stabilization and revegetation in the reclamation of sites disturbed by construction and the operation of oil and gas facilities.

shale: A laminated sediment in which the constituent particles are predominantly of the clay grade.

significant impact: A meaningful standard to which an action may impact the environment. The impact may be beneficial, adverse, direct, indirect, or cumulative and may be short-term or long-term.

silt: Any earthy material composed of fine particles, smaller than sand but larger than clay, suspended in or deposited by water.

siltstone: A sedimentary rock whose grain size is intermediate in size, falling between the coarser sandstone and finer mudstone.

site-specific analysis: Environmental assessments designed to address issues related to small projects, such as individual wells, generally under the guidance of a more comprehensive NEPA.

socioeconomics: The study of impacts on a region‘s current and projected population and relative demographic characteristics (housing, economy, government, etc.).

soil horizon: A layer of soil or soil material roughly parallel to the land surface and differing from adjoining genetically related layers in physical, chemical, and biological properties or characteristics, such as color, structure, and texture.

soil productivity: The capacity of a soil to produce a specific crop, such as fiber and forage, under defined levels of management. It is generally dependent on available soil moisture, nutrients, and length of growing season.

species of concern: Species of concern include federally listed threatened or endangered species, species proposed for listing, BLM sensitive species, WGFD priority species, and species considered rare or important by the Wyoming Natural Diversity Database.

Spill Prevention, Control and Countermeasure Plan (SPCCP): Plan to help prevent any discharge of oil into navigable waters or adjoining shorelines.

stipulation: A legal requirement that is part of the terms of a mineral lease. Some stipulations are standard on all federal leases. Other stipulations may be applied to the lease at the discretion of the surface management agency to protect valuable surface resources. Stipulations are supported by the NEPA process; without NEPA support, a stipulation cannot be added to the lease.

stratigraphy: Study of the formation, composition, and sequence of sediments, whether consolidated or not.

stratotype: A designated unit of accessible rocks that contain clear-cut characteristics of a particular lithostratigraphic unit.

structural basin: A large depression of structural origin.

substrate: Material consisting of silts, sands, gravels, boulders, and/or woody debris found on the bottom of a stream channel.

sulfur oxide (SO_x): Sulfur oxide (SO_x) refers to one or more of the following:

- Lower sulfur oxides (S_nO, S_7O_2 and S_6O_2)
- Sulfur monoxide (SO)
- Sulfur dioxide (SO_2)
- Sulfur trioxide (SO_3)
- Higher sulfur oxides (SO_{3+x} where $0<x\leq1$)

The chemical compound is produced various industrial processes. Since coal and petroleum often contain sulfur compounds, their combustion generates sulfur oxides.

Sundry Notice: A form designed for submitting proposals to perform or modify certain well operations and reports of such operations when completed as indicated on Federal and Indian lands as pursuant to applicable Federal law and regulations.

surface-disruptive (human) activities: The physical presence, sounds, and movements of people and their activities that are likely to cause displacement of or excessive stress to wildlife during critical life stages (breeding, nesting, birthing) or during periods of severe winter weather conditions. Examples of disruptive activities include noise, traffic, or human presence regardless of the purpose of the activity. Stipulations to mitigate disruptive activities can be absolute or timing-based.

surface-disturbing activities: Any authorized action that disturbs vegetation and surface soil, increasing erosion potential above normal site conditions. This definition typically applies to mechanized or mechanical disturbance. However, intense or extensive use of hand or motorized hand tools may fall under this definition. Examples of surface disturbing activities include construction of well pads and roads, pits and reservoirs, pipelines and power lines, mining, and vegetation treatments.

surface water: Water that sits or flows on the surface of the earth, including oceans, rivers, streams, lakes, wetlands, and reservoirs constructed by humans.

‘take’: In the Endangered Species Act, to "take" a species means to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct."

Tertiary: The older of the two geologic periods comprising the Cenozoic Era; the system of strata deposited during that period.

threatened and endangered species: In the Endangered Species Act, an endangered species is defined as one "in danger of extinction throughout all or a significant portion of its range" and a threatened species is one that is "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range."

topographic basin: A large depression of erosional origin.

topography: The features of the earth, including relief, vegetation, and waters.

topsoil: The uppermost layers of naturally occurring soils suitable for use as a plant growth medium.

Total Dissolved Solids (TDS): Total amount of dissolved material, organic or inorganic, contained in a sample of water.

Tribal lands: Tribal lands are defined by federal law differently and according to various regulations, such as the National Historic Preservation Act, which also includes a separate designation for dependent Indian communities. In general, Tribal Land is land held in trust by the United States for Indian tribes for the collective benefit and use of its tribal members. Also included in this definition are Individual Indian Trust Lands (or allotted lands), which are lands that were originally granted in trust status to individual Indians to encourage individualism of land use and ownership. These lands are considered Indian (or Tribal) lands. As these lands are non-severable in general, fractionalization may have taken place over the decades, resulting in multiple owners–each with a divided or undivided interest in a tract. Whereas Tribal trust lands are managed by the Tribe (in cooperation with the Bureau of Indian Affairs), Individual Indian Trust lands are managed by the Bureau of Indian Affairs (with input by the allottees) for actions that affect the land, such as leases or right-of-ways. Separately, there may be lands owned by the Tribe in fee status also considered under the definition of Tribal Lands. These lands are privately owned and are generally not subject to federal oversight unless an action takes place which creates a federal regulatory nexus. For accurate information on Tribal lands, consultation should take place with the appropriate Indian Tribe land management office and/or the Bureau of Indian Affairs agency office in charge of the affected Indian community.

trona: An evaporite mineral that is used as a source of sodium carbonate.

turbidity: A measurement of the total suspended solids in water.

two-track: A road that has not been constructed or maintained but that has been created by repeated use.

understory: A layer of vegetation underlying a layer of taller vegetation, such as brush and grass under trees.

ungulates: Hoofed mammals such as deer and elk.

Utah Administrative Code: An official publication of the Division of Administrative Rules, mandated by Section 63-46a-10. It is Utah's equivalent to the Code of Federal Regulations. The Utah Administrative Code is "evidence of the administrative law of the state of Utah" and an "authorized compilation of the administrative law of Utah" (Section 63-46a-16).

Utah Noxious Weed Act: Officially designates weeds as noxious for the State of Utah, as per the authority vested in the Commissioner of Agriculture under Section 4-17-3, and requires control and prevention of these weeds throughout the state.

vegetation community: A broad grouping of native plant species and/or associations based on the dominant species.

visibility: The visual quality of the view or scene in daylight, with respect to color, rendition, and contrast definition.

Visual Management System (VMS): Part of the National Forest Landscape Management Program that inventories visual resources and provides measurable standards for management of those resources.

Visual Quality Objectives (VQOs): In the Visual Management System, the physical components of the landscape as Variety Classes are combined with the user related Sensitivity Levels to produce Visual Quality Objectives of management. There are five differing levels of Visual Quality Objectives; Preservation (P), Retention (R), Partial Retention (PR), Modification (M), and Maximum Modification (MM).

visual resource: The composite of basic terrain, geologic features, water features, vegetation patterns, and land use effects that typify a land unit and influence the visual appeal the unit may have for viewers.

Visual Resource Management (VRM): A system of visual management used by the BLM. The program has a dual purpose: (1) to manage the quality of the visual environment, and (2) to reduce the visual impact of development activities while maintaining effectiveness in all BLM resource programs. The system uses four classes for categorizing visual resources.

> **Class I -** Natural ecological changes and limited management activity are allowed. Any contrasts created within the characteristic landscape must not attract attention. This classification is applied to wilderness areas, wild and scenic rivers, and other similar situations.
>
> **Class II** - Changes in any of the basic elements (form, line, color, texture) caused by a management activity should not be evident in the characteristic landscape. Contrasts are seen but must not attract attention.
>
> **Class III** - Contrasts to the basic elements caused by a management activity are evident but should remain subordinate to the existing landscape.
>
> **Class IV -** Any contrast may attract attention and be a dominant feature of the landscape in terms of scale, but it should repeat the form, line, color, and texture of the characteristic landscape.

volatile organic compound (VOC): Organic chemical that has a high vapor pressure and easily form vapors at normal temperature and pressure. Any organic compound that participates in atmospheric photochemical reactions, except those designated by the EPA as having negligible photochemical reactivity.

water quality: Refers to a set of chemical, physical, or biological characteristics that describe the condition of a river, stream, or lake. The quality of water determines what beneficial uses it can support.

watershed: The total land area that drains to a given watercourse or body of water.

Waters of the U.S.: A jurisdictional term from Section 404 of the Clean Water Act referring to water bodies such as lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds with defined bed and bank.

well or wellbore: The hole drilled from the surface to the gas-bearing formation, several of which may be developed from a single well pad.

well pad: Relatively flat work area (surface location) that is used for drilling a well or wells and for producing from the well once it is completed.

wetland: Areas that are inundated by surface water or groundwater with a frequency sufficient to support—and under normal circumstances do or would support—a

prevalence of vegetation or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction.

winter range: An area where migratory (and sometimes non-migratory) animals congregate during the winter season.

workover: Well maintenance activities that require onsite mobilization of a drill rig to repair the well bore equipment (casing, tubing, rods, or pumps) or the wellhead. In some cases, a workover may involve development activities to improve production from the target formation.

yearlong range: Locations where specific species are able to reside in the same area throughout the year.

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