Environmental Assessment for Anadarko Petroleum Corporation

Mohawk Oil and Gas Exploration and Development Project

Bureau of Land Management
Casper Field Office
Casper, Wyoming

WY-060-EA14-079

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prepared by

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BLM
Wyoming High Plains District – Casper Field Office

TABLE OF CONTENTS

Page No.

1.0 INTRODUCTION 1-1
1.1 Background 1-3
1.2 Location 1-4
1.3 Purpose and Need for the Proposed Action 1-4
1.4 Relationship to Statutes, Regulations, Plans, or Other Environmental Analyses 1-6
1.5 Scoping, Public Involvement, and Issues 1-8
1.6 Alternatives Considered but Eliminated From Further Analysis 1-9

2.0 PROPOSED ACTION AND ALTERNATIVES 2-1
2.1 Proposed Action 2-1
2.1.1 Drilling and Completion Well Pads 2-4
2.1.2 Drilling, Construction, and Production Design Features 2-7
2.1.3 Access Roads 2-8
2.1.4 Power Lines 2-9
2.1.5 Drilling and Completion Water Sources, Amounts, and Disposal 2-10
2.1.6 Completion 2-10
2.1.7 Pipelines 2-12
2.1.8 Drilling and Completion Sequence 2-13
2.1.9 Production 2-13
2.1.10 Interim and Final Reclamation 2-14
2.1.11 Vehicle Traffic 2-16
2.1.12 Waste and Hazardous Materials Management 2-16
2.1.13 Surface Disturbance Summary 2-18
2.2 No Action Alternative 2-20
2.3 Applicant-Committed Environmental Protection Measures 2-20
2.3.1 Mitigation Measures 2-20
2.3.2 Site-Specific Onsite Commitments 2-20

3.0 AFFECTED ENVIRONMENT 3-21
3.1 Air Resources 3-21
3.1.1 Climate Change and Greenhouse Gases 3-21
3.1.2 Air Quality and Visibility 3-28
3.2 Heritage and Visual Resources 3-36
3.2.1 Cultural Resources 3-36
3.2.2 Paleontology 3-36
3.2.3 Visual Resources 3-36
3.3 Range Management 3-37
3.4 Soils and Ecological Sites 3-37
3.5 Vegetation 3-41

3.5.1 Plant Communities 3-41
3.5.2 Invasive, Non-Native Plant Species 3-41
3.6 Water Resources 3-42
3.6.1 Groundwater 3-42
3.6.2 Surface Water and Wetlands 3-43
3.7 Wildlife, Special Status Species, and Threatened and Endangered Species 3-44
3.7.1 Big Game Species 3-45
3.7.2 Raptors 3-47
3.7.3 Threatened and Endangered Species 3-48
3.7.4 BLM Sensitive Species 3-50
3.7.5 Migratory Bird Species 3-57

4.0 ENVIRONMENTAL EFFECTS 4-1
4.1 No Action Alternative 4-1
4.2 Proposed Action 4-2
4.2.1 Air Resources 4-2
4.2.2 Heritage and Visual Resources 4-5
4.2.3 Range Management 4-9
4.2.4 Soils and Ecological Sites 4-10
4.2.5 Vegetation 4-14
4.2.6 Water Resources 4-17
4.2.7 Wildlife, Special Status Species, and Threatened and Endangered Species 4-19

5.0 CUMULATIVE EFFECTS 5-1

6.0 LIST OF PREPARERS 6-1

7.0 REFERENCES 7-1

APPENDIX A - APPLICANT-COMMITTED MITIGATION MEASURES

APPENDIX B - INTEGRATED WEED AND PEST MANAGEMENT PLAN

LIST OF TABLES

Page No.

Table 1-1: Proposed Mohawk EA Well Pads and Wells 1-3
Table 1-2: Surface Ownership within the Project Area 1-4
Table 1-3: Mineral Ownership within the Project Area 1-4
Table 1-4: Major Federal, State, and Local Permits, Approvals, and Authorizing Actions for the Mohawk EA Project 1-6
Table 2-1: Site-Specific Well Locations 2-2
Table 2-2: Anticipated Drilling and Completion Sequence and Timing (Per Well) 2-13
Table 2-3: Vehicle Traffic Estimate for a Typical Well under the Proposed Action 2-16
Table 2-4: Summary of Surface Disturbance from the Proposed Action 2-19
Table 2-5: Issues Addressed during Onsite Reconnaissance of Site-Specific Well Pads 2-20
Table 3-1: Air Quality-Monitoring Sites within the High Plains District Office[1] 3-30
Table 3-2: Air Quality Conditions 3-31
Table 3-3: National Parks, Wilderness Areas, and National Monuments 3-33
Table 3-4: Grazing Allotments in the Project Area 3-37
Table 3-5: Dominant Soils and Ecological Sites within the Project Area 3-38
Table 3-6: Vegetation Cover Types in the Project Area 3-41
Table 3-7: Designated Noxious Weeds in Wyoming 3-42
Table 3-8: Permitted Water Wells within the Project Area 3-43
Table 3-9: NWI Wetlands in the Project Area 3-44
Table 3-10: Results of Wildlife Surveys Conducted for Well Pads #1, #2, and #3 3-44
Table 3-11: Big Game Species Seasonal Ranges within Project Area 3-46
Table 3-12: Known Raptor Nest Sites within 0.5-Mile of Project Area 3-48
Table 3-13: Federally Listed Species Identified as Potentially Occurring within the Project Area 3-49
Table 3-14: Wyoming BLM Special Status Sensitive Species and Habitat Preferences 3-50
Table 3-15: Migratory Birds Potentially Occurring in the Project Area 3-57
Table 4-1: Per Well Criteria Pollutant Emissions Estimate for a Typical Well in the Project Area – Pad Construction and Drilling/Completion Phases 4-3
Table 4-2: Yearly Criteria Pollutant Per Well Emissions Estimate for a Typical Well in the Project Area – Production Phase[1] 4-3
Table 4-3: Soil Impacts for Site-Specific Well Pads 4-11
Table 5-1: Cumulative Effects for the Mohawk EA 5-2
Table 6-1: List of EA Preparers 6-1

LIST OF FIGURES

Page No.

Figure 1-1: Mohawk EA Project Area 1-2
Figure 2-1: Typical Drilling and Completion Pad Layout without Large Capacity Water Storage Tank 2-5
Figure 2-2: Typical Drilling and Completion Pad Layout with Large Capacity Water Storage Tank 2-6
Figure 3-1: Current (1980-1999) Total Annual Precipitation (Millimeters) 3-24
Figure 3-2: Current (1980-1999) Mean Annual Temperature (Degrees Celsius) 3-24
Figure 3-3: Standard Visual Range (SVR) for the Thunder Basin IMPROVE Site through 2013 3-34
Figure 3-4: Standard Visual Range (SVR) for the Cloud Peak IMPROVE Site through 2013 3-35
Figure 3-5: Standard Visual Range (SVR) for the Cave Wind IMPROVE Site through 2012 3-35

LIST OF ABBREVIATIONS

Abbreviation	Term/Phrase/Name
$\mu g/m^3$	Micrograms per cubic meter
ACHP	Advisory Council on Historic Preservation
AO	Authorizing Officer
APC	Anadarko Petroleum Corporation
APD	Application for permit to drill
AQRV	Air quality-related values
AUM	Animal unit month
bbl	Barrel
BGEPA	Bald and Golden Eagle Protection Act
BLM	Bureau of Land Management
BMP	Best management practice
Btu	British Thermal Unit
CAA	Clean Air Act
CBNG	Coal bed natural gas
CCS	Center for Climate Strategies
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFO	Casper Field Office
CFR	Code of Federal Regulations
CH_4	Methane
CIA	Cumulative Impacts Area

Abbreviation	Term/Phrase/Name
cm	Centimeters
CO	Carbon monoxide
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
COA	Condition of Approval
CWA	Clean Water Act
DO	District Office
DOI	U.S. Department of the Interior
EA	Environmental Assessment
EFM	Electronic flow measurement
EO	Executive Order
EPA	U.S. Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
ESA	Endangered Species Act
F	Fahrenheit
FEIS	Final Environmental Impact Statement
FLPMA	Federal Land Policy and Management Act
GAP	Gap Analysis Program
GHG	Greenhouse gas
ha	Hectares
HFC	Hydrofluorocarbons
IMPROVE	Interagency Monitoring of Protected Visual Environments

Abbreviation	Term/Phrase/Name
IPMP	Integrated pest management plan
K	Koschmieder Coefficient
LACT	lease automatic custody transfer
MBTA	Migratory Bird Treaty Act
Met	Meteorology
MLA	Mineral Leasing Act
MMt	Million metric tons
MOU	Memorandum of Understanding
MSDS	Material Safety Data Sheets
N_2O	Nitrous oxide
NAAQS	National Ambient Air Quality Standards
NADP	National Atmospheric Deposition Program
NCA	National Climate Assessment
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NO_2	Nitrogen dioxide
NOS	Notice of Staking
NO_x	Nitrogen oxides
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NSO	No surface occupancy
NWI	National Wetlands Inventory

Abbreviation	Term/Phrase/Name
O_3	Ozone
OSHA	Occupational Safety and Health Administration
Pb	Lead
PFC	Perfluorocarbons
PFYC	Potential Fossil Yield Classification
PM	Particulate matter
POD	Plan of Development
ppb	Parts per billion
ppm	Parts per million
PSD	Prevention of Significant Deterioration
PUP	Pesticide utilization proposal Integrated pest management plan
REA	Rapid Ecoregional Assessment
RFFA	Reasonably foreseeable future action
RMP	Resource Management Plan
ROD	Record of Decision
ROW	Right-of-way
SF_6	Sulfur hexafluoride
SHPO	State Historic Preservation Office
SLAMS	State and Local Air Monitoring Stations
SO_2	Sulfur dioxide
SPCC	Spill Prevention, Control, and Countermeasure
SPM	Special Purpose Monitoring

Abbreviation	Term/Phrase/Name
SVR	Standard visual range
SWPPP	Storm water pollution prevention plan
USACE	U.S. Army Corps of Engineers
USC	United States Code
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
VOC	Volatile organic compound
VRM	Visual Resource Management
W.S.	Wyoming Statute
WAAQS	Wyoming Ambient Air Quality Standards
WARMS	Wyoming Air Resource Monitoring System
WDEQ	Wyoming Department of Environmental Quality
WGFD	Wyoming Game and Fish Department
WOGCC	Wyoming Oil and Gas Conservation Commission
WSEO	Wyoming State Engineer’s Office
WSPHST	Wyoming State Parks, Historic Sites and Trails
WWDC	Wyoming Water Development Commission
WYDOT	Wyoming Department of Transportation
WYNDD	Wyoming Natural Diversity Database
WYPDES	Wyoming Pollutant Discharge Elimination System

1.0 INTRODUCTION

Anadarko Petroleum Corporation (APC), operating as Kerr-McGee Oil & Gas Onshore LP and Anadarko E&P Onshore LLC, proposes the Mohawk Oil and Gas Exploration and Development Project (Project) within a 19,049-acre area (Project Area) in Converse County, Wyoming (Figure 1-1). The proposed Project includes the exploration and development of oil and gas resources on lands with primarily private (fee) surface ownership and federal subsurface minerals managed by the Bureau of Land Management (BLM) Casper Field Office (CFO). If the proposed Project were approved, APC would develop as many as 32 oil and gas wells on 6 well pads (1 existing and 5 proposed) using horizontal drilling techniques. The proposed Project would also include the installation of the necessary equipment and facilities to enable the commercial operation of these wells, should they reach the production phase.

This Environmental Assessment (EA), also referred to as the Mohawk EA, has been prepared in accordance with the National Environmental Policy Act of 1969 (NEPA), as amended, to analyze the potential impacts that could result from BLM's actions associated with this Project. The Proposed Action is for BLM to approve APC's oil and gas development plan for the Project Area. This EA serves as a decision-making tool that can assist the BLM in making an informed determination as to whether any significant impacts could result from the Proposed Action. An EA provides evidence for determining whether to prepare an Environmental Impact Statement (EIS) or to support a Finding of No Significant Impact (FONSI). If the BLM determines that this Project could result in significant impacts, as based on the analysis in the EA, then an EIS would be prepared for the Project. A FONSI would be prepared if the Proposed Action would not result in significant environmental impacts (effects).

This EA provides site-specific analyses of 13 of the proposed wells on 3 of the well pads (1 existing and 2 proposed well pads for which specific locations have been determined) and a conceptual-level analysis of the other 19 proposed wells on 3 proposed well pads (to be located somewhere within the Mohawk EA Project Area). The Proposed Action requires BLM approval of the individual wells through the application for permit to drill (APD) process. Site-specific APDs have been submitted for the 13 site-specific wells. Because the specific locations of the 19 additional wells are not yet known, future APDs submitted for these 19 additional wells would be reviewed for compliance with the siting and mitigation requirements described in this EA.

This EA is tiered to the Record of Decision (ROD) and December 2007 Approved Casper Resource Management Plan (RMP), including the supporting Final Environmental Impact Statement (FEIS) and RMP amendments, pursuant to 40 Code of Federal Regulations (CFR) 1508.28 and 1502.21 (BLM,

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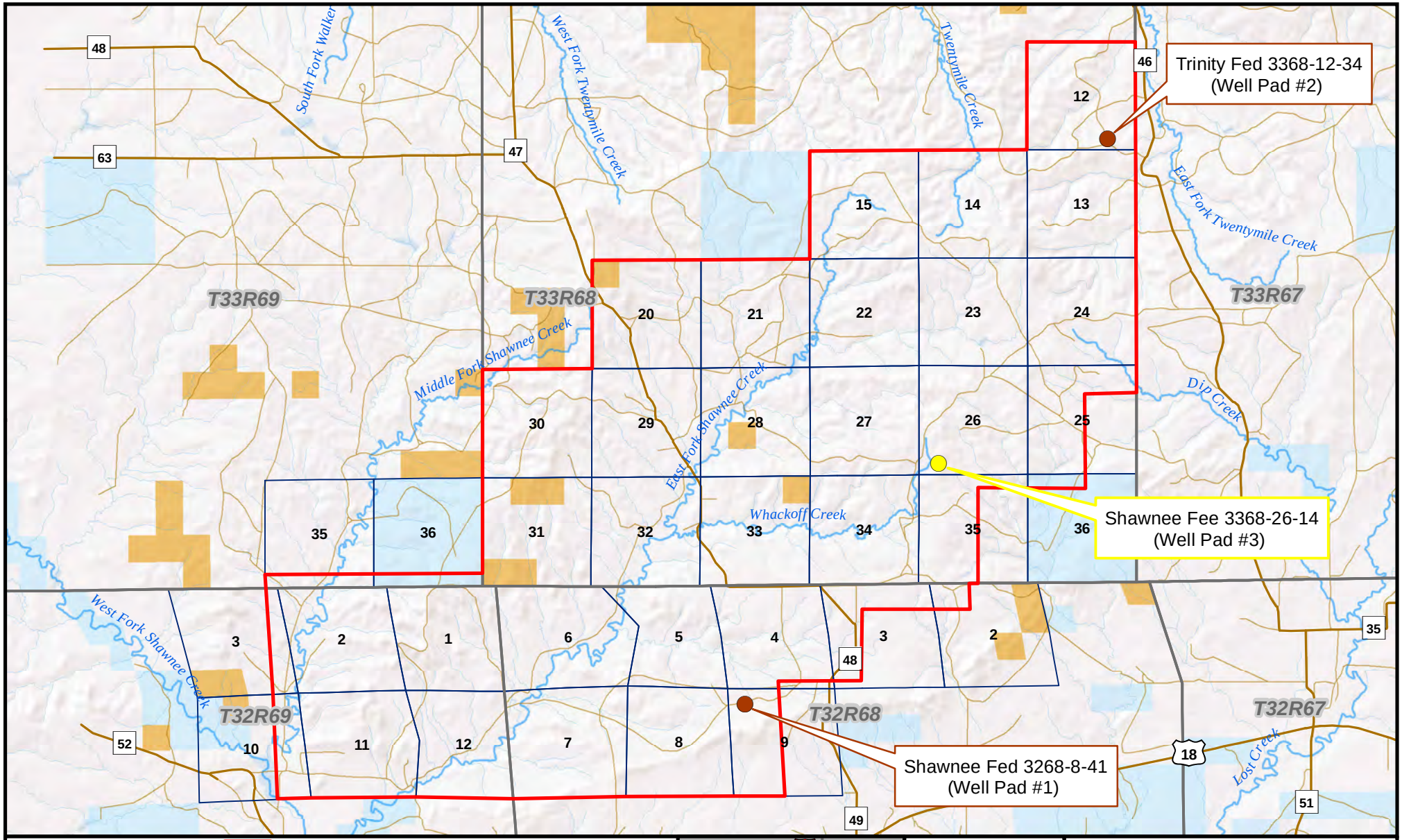

Existing Well Pad
Proposed Well Pad

Surface Ownership

BLM
State

Project Boundary
Township Boundary
Section Boundary
Existing Roads
Streams

NORTH

0 0.5 1
Miles

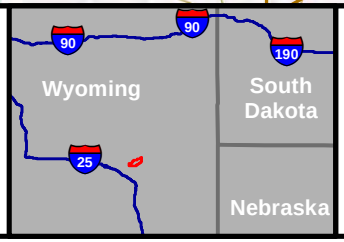

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Figure 1-1 - Project Area
Anadarko Petroleum Corp.
Mohawk Oil and Gas Exploration and Development Project
Environmental Assessment

Source: Anadarko, BLM, BMcD, ESRI

Issued: 12/18/2014

2007a and 2007b). The Casper RMP designates the BLM mineral estate in the Project Area as available for oil and gas lease consideration.

1.1 Background

On January 13, 2014, APC met with the CFO to discuss the potential to complete an EA that would include both site-specific and conceptual-level analyses for the development of the Project Area. After additional follow-up discussions, APC and the CFO agreed to produce an EA that would include site-specific analyses of three well pads (one existing and two proposed) and a conceptual analysis of three additional new well pads. Table 1-1 includes a breakdown of the well pads and proposed new wells analyzed in this EA.

Table 1-1: Proposed Mohawk EA Well Pads and Wells

Well Pad Number	Well Pad	Number of Wells
#1	Shawnee Fed 3268-8-41 (proposed)	2
#2	Trinity Fed 3368-12-34 (proposed)	8
#3	Shawnee Fee 3368-26-14 (existing)	3
#4	Conceptual A	As many as 19
#5	Conceptual B	
#6	Conceptual C	
Total:	6 (3 site-specific and 3 conceptual)	32 (13 site-specific and 19 conceptual)

Site-specific APDs have been submitted for the 13 site-specific wells. The following actions have occurred to date:

- Notice of Staking (NOS) applications for the two wells associated with well pad #1 were submitted to BLM on July 19, 2012.
- Representatives from BLM, APC, and contractors conducted pre-approval onsite reconnaissance of the proposed well pad location #1 on July 24, 2012.
- APDs for the two wells (well pad #1) were submitted to BLM on September 19, 2012.
- NOS applications for the 11 wells associated with well pads #2 and #3 were submitted to BLM on February 7, 2014.
- Representatives from APC, BLM, and contractors conducted pre-approval onsite reconnaissance of the proposed well pad locations #2 and #3 on April 8, 2014.

- APDs for 11 wells (well pads #2 and #3) were submitted to BLM on May 7, 2014.
- The proposed well pad and access road locations were adjusted, when necessary, based on these field inspections. This EA analyzes the final locations agreed on during the field inspections.

APDs for the 19 conceptual wells will be submitted following completion of this EA and once specific well pad locations have been determined.

1.2 Location

The Mohawk EA Project Area encompasses 19,049 acres of mixed federal, State, and private (fee) surface estate in eastern Converse County, Wyoming (Figure 1-1). The majority of the Project Area surface is under private (fee) ownership, with a few federal (administered by the BLM) and State parcels scattered throughout the area (Table 1-2).

Table 1-2: Surface Ownership within the Project Area

Surface Ownership	Acres	Percent of Project Area
Federal – administered by BLM	282	1%
State of Wyoming	122	1%
Private (fee)	18,644	98%
Total:	19,049	100%

Source: Gray, 2014

The mineral estate within the Project Area is split primarily between federal and private (fee), with a very small percentage of State mineral ownership (Table 1-3).

Table 1-3: Mineral Ownership within the Project Area

Mineral Ownership	Acres	Percent of Project Area
Federal (oil and gas)	7,519	39%
State of Wyoming	82	1%
Private (fee)	11,447	60%
Total:	19,049	100%

Source: Gray, 2014; Abeloe, 2013

1.3 Purpose and Need for the Proposed Action

Development of oil and gas resources is consistent with the mission of the BLM. The Mineral Leasing Act of 1920 (MLA), as amended, provides that exploration and development of domestic oil and gas is in the best interest of the United States. The intent of the MLA and its implementing regulations are to allow

lessees or potential lessees to explore for and develop oil and gas or other mineral reserves on federally administered lands. The Federal Land Policy and Management Act of 1976 (FLPMA) mandates that the BLM manage public lands on the basis of multiple use [43 United States Code (USC) § 1701(a)(7)]. Mineral extraction is identified as one of the principal uses of public lands in Section 103 of FLPMA [43 USC § 1702(c)]. The BLM is responsible for administering activities consistent with rights associated with valid existing leases. Mineral exploration and production are allowed on lands in the Project Area as long as they are in conformance with the terms and conditions of the applicable federal oil and gas leases and the Casper RMP/ROD and FEIS. The Casper RMP specifically identifies the BLM mineral estate in the Project Area as leasable for oil and gas.

Under the proposed Project, APC would exercise existing lease rights to drill for, extract, remove, and market commercial quantities of oil and natural gas. The MLA and related regulations, as well as the policies by which they are implemented, recognize the right of lease holders to develop federal mineral resources to meet continuing needs and economic demands, so long as unnecessary or undue degradation is not incurred. These rights include the right to build and maintain necessary improvements, subject to lease and/or landowner terms and conditions. The lessee has the right to use as much of the leased lands as is necessary to explore, develop, and/or dispose of the leased resource (43 CFR 3101.1-2) subject to lease terms, conditions, and stipulations. The FLPMA mandates that these rights be permitted in a manner that provides adequate protection of other resource values.

Purpose – The purpose of the action is to allow for the exploration and development of oil and gas resources on federal mineral leases consistent with lease rights, where valid and existing rights occur.

Need – The need for exploration and development of oil and gas resources in the Project Area is established by the BLM's responsibility under the MLA of 1920 (30 USC § 188, et seq.), as amended, to promote the mining of oil and gas in the public domain. Deposits of oil and gas owned by the United States are subject to disposition in the form and manner provided by the MLA, where applicable, through the land use planning process.

Decision to be made – The BLM will decide whether or not to authorize the proposed Mohawk oil and gas exploration and development project on federal mineral leases and, if so, under what terms and conditions.

1.4 Relationship to Statutes, Regulations, Plans, or Other Environmental Analyses

Pursuant to 40 CFR 1508.28 and 1502.21, this EA tiers to and incorporates by reference the information and analysis contained in the Casper RMP/ROD, approved in December 2007, including the FEIS and any amendments. One of the goals of the Casper RMP/ROD (Goal MR 2.1 on page 2-15) is to "maintain oil and gas leasing, exploration, and development, while minimizing impacts to other resource values." In the FEIS, Appendix D "Oil and Gas Operations" specifies that "if necessary, site-specific mitigation can be added to the APD as a Condition of Approval (COA) for protection of surface and/or subsurface resource values in the vicinity of the proposed activity." Based on the Casper RMP, the Project Area has been determined to be suitable for oil and gas leasing. The proposed Project, with incorporated mitigation measures to reduce impacts to other resource values, is designed to be consistent with the land use decisions and resource management goals and objectives.

This EA has been prepared in accordance NEPA and is in compliance with applicable regulations and laws passed subsequent thereto, including the Council on Environmental Quality (CEQ) regulations (40 CFR 1500-1508). The proposed Project is designed to be consistent with other federal, State and local laws, rules and regulations, and APC would procure required permits or easements prior to the commencement of drilling operations and subsequent evaluation of the Project's proposed wells.

A list of the major permits, approvals, and authorized actions necessary to construct, operate, maintain, and abandon Project facilities is provided in Table 1-4. This list is intended to provide an overview of the key regulatory requirements that would govern Project implementation. Additional approvals, permits, and authorizing actions may be necessary, as identified through the environmental review process.

Table 1-4: Major Federal, State, and Local Permits, Approvals, and Authorizing Actions for the Mohawk EA Project

Agency	Action	Authority
Bureau of Land Management (BLM)	Responsible for National Environmental Policy Act (NEPA) compliance, including the issuance of applications for permit to drill (APDs) and authorization of right-of-way (ROW) grants (whether to approve, approve with conditions, or deny the application)	NEPA; Federal Land Policy and Management Act of 1976 (FLPMA); Mineral Leasing Act of 1920 (MLA); 43 Code of Federal Regulations (CFR) 3160, Onshore Oil and Gas Order No. 1 and 2

Agency	Action	Authority
U.S. Fish and Wildlife Service (USFWS)	Coordination, consultation, and impact review on federally listed threatened and endangered species, eagles, and migratory birds	Fish and Wildlife Coordination Act of 1934, as amended 1946, 1958, 1977; Section 7 of the Endangered Species Act (ESA) of 1973; Migratory Bird Treaty Act (MBTA) of 1918, as amended; Bald and Golden Eagle Protection Act (BGEPA) of 1940
U.S. Army Corps of Engineers (USACE)	Issuance of permits for construction involving wetlands and other waters of the United States (Section 404)	Clean Water Act (CWA) of 1977; Rivers and Harbors Act of 1899
U.S. Environmental Protection Agency (EPA)	Approval of Spill Prevention, Control, and Countermeasure (SPCC) Plans	40 CFR 112
Wyoming Game and Fish Department (WGFD)	Coordination, consultation, and impact review on State-listed species of concern and other fish and wildlife interests	Fish and Wildlife Coordination Act of 1934, as amended 1946, 1958, 1977; Wyoming Statute (W.S.) 23-1-302; W.S. 35-12-107(b)(x) and 35-12-109(a)(xii)
Wyoming Department of Environmental Quality (WDEQ) – Water Quality Division	Wyoming Pollutant Discharge Elimination System (WYPDES) permits for discharging waste water and storm water runoff; turbidity waiver to exceed turbidity criteria	WDEQ Rules and Regulations, Chapter 18, Wyoming Environmental Quality Act (W.S. 35-11-301 through 35-11- 311); Section 405 of the CWA (40 CFR 122–124)
Wyoming State Engineer's Office (WSEO)	Permits to appropriate groundwater (use, storage, wells, dewatering) and approval of temporary alternative use of existing appropriations	W.S. 41-121 through 147 (Form UW-5); W.S. 41-201 (Form SW-1)
WDEQ – Air Quality Division	Issuance of air quality permits to construct and operate	Clean Air Act (CAA); Wyoming Environmental Quality Act (W.S. 35-11-201 through 35-11-212)
Wyoming State Parks, Historic Sites and Trails (WSPHST); Wyoming State Historic Preservation Office (SHPO)	Coordination, consultation, and impact review on State parks and cultural resources for the EA	Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended, 16 United States Code (USC) 570; W.S. 35-12-109(a)(xiii)(C)
WDEQ – Solid Waste Division	Construction fill permits and industrial waste facility permits for solid waste disposal during construction and operations	Wyoming Environmental Quality Act (W.S. 35-11-501 through 35-11-520)
Wyoming Department of Transportation (WYDOT)	Permits for oversize, overlength, and overweight loads	Chapters 17 and 20 of the Wyoming Highway Department Rules and Regulations

Agency	Action	Authority
Converse County Board of Commissioners	Notice of Industrial Activity – required prior to construction or expansion of mineral, oil or gas extraction facilities; may require negotiation of a road use agreement	Converse County, Wyoming Resolution No. 07-12
Converse County Road and Bridge Department	Issuance of permits, such as access permits, oversize/overweight permits, and bore cut permits	County Rules and Regulations; Converse County, Wyoming Resolution No. 04-13
Wyoming Oil and Gas Conservation Commission (WOGCC)	Permits to use earthen pit on nonfederal lands; regulation of downhole spacing for all oil and gas wells; authorization for flaring or venting of gas; permit for Class II underground injection wells, well plugging and abandonment; APDs, and change in depletion plans	State of Wyoming Statutes - W.S. 30-5-101 through 30-5-119, as amended

1.5 Scoping, Public Involvement, and Issues

Comments have been solicited previously as part of the process for the development of oil and gas resources on federal mineral leases in the vicinity of the proposed Project Area, including for exploratory development associated with the East Converse EA (WY-060-EA12-227) in September 2012 (BLM, 2012).

The East Converse EA analyzed 18 well pad locations with a range of 18 to 21 wells. The Mohawk EA Project Area is located immediately south of and adjacent to the East Converse EA boundary. During the 30-day comment period, 12 comment letters were received. Of the 12 comment letters the BLM received, 4 were written by private citizens, 1 by a federal agency, 1 by a State agency, 1 by a county agency, 4 from groups or associations (Thunder Basin Grasslands Prairie Ecosystem Association, Petroleum Association of Wyoming, Powder River Basin Resource Council, and Alliance for Historic Wyoming), and 3 from industry representatives. The comments, BLM's responses, and errata for tracking edits to the East Converse EA are contained in the document *Converse County EAs Comment Response and Errata* and incorporated as part of the decision record for the East Converse EA.

Due to the similar nature, scope, scale and location of the Mohawk EA to the other analyzed federal action, it is expected that this Proposed Action would result in similar issues and comments, so external scoping was not conducted. Internal scoping was performed with an interdisciplinary team of specialists

from the BLM and APC environmental consultants. Issues identified during the internal scoping process are discussed in Section 3.0. The EA was released to the public for a 30-day comment period. A press release announcing the availability of the EA for comments was published on {INSERT DATE}. The press release stated that the comment period for the EA would run for 30 days and end on {INSERT DATE}. For the specific comments and responses, see Appendix C, Public Comments and Responses.

1.6 Alternatives Considered but Eliminated From Further Analysis

APC considered alternatives that solely involved development of private (fee) minerals and would not include development of the federal mineral estate in the Project Area. APC also considered smaller-scale development of fewer than 32 wells. However, these alternatives would not meet APC's Project objectives to exercise existing lease rights to drill for, extract, remove, and market commercial quantities of oil and natural gas. As such, these alternatives were removed from further consideration.

2.0 PROPOSED ACTION AND ALTERNATIVES

This EA analyzes two alternatives, the Proposed Action Alternative and the No Action Alternative.

2.1 Proposed Action

The Proposed Action is for BLM to approve APC's development of as many as 32 oil and gas wells on 6 well pads (1 existing and 5 proposed) using horizontal drilling techniques within a 19,049-acre Project Area located in Converse County, Wyoming (Figure 1-1). The target zones for the Proposed Action include the Niobrara, Frontier, Mowry, Shannon, Sussex, and Turner geologic formations. APC anticipates the life of each productive well to be as many as 40 years. The Proposed Action includes three site-specific well pads and three conceptual well pads.

Site-specific wells – Under the Proposed Action, APC would construct the following wells/well pads, for which specific locations have been determined:

- Drill two new wells on proposed well pad #1 (Shawnee Fed 3268-8-41)
- Drill eight new wells on proposed well pad #2 (Trinity Fed 3368-12-34)
- Drill three new wells on existing well pad #3 (Shawnee Fee 3368-26-14)

Legal descriptions of the surface locations and production zones for the site-specific wells are provided in Table 2-1.

Conceptual wells – The Proposed Action includes the construction of as many as 19 additional horizontal wells on as many as 3 additional new well pads within the Mohawk EA Project Area. The locations of the proposed well pads will be determined based on the location of the subsurface reservoir, the topography of the area, and Wyoming Oil and Gas Conservation Commission (WOGCC) well spacing requirements (WOGCC, 2010). Each well pad would contain between 1 and 9 wellbores[1].

All wells would be located outside of environmentally constrained areas (i.e., areas designated by the BLM as allowing no surface occupancy [NSO] due to environmental concerns). All lease operations would be conducted in compliance with applicable laws, regulations (43 CFR 3100 et al.), Onshore Oil and Gas Orders, the approved plan of operations, and applicable Notices to Lessees. Operations on federal lands also would be conducted in compliance with 43 CFR 2800 et al.

[1] A wellbore is the actual hole that is drilled to form the well.

Table 2-1: Site-Specific Well Locations

Well Pad Number	Well Pad Name	Well Name	Lease Numbers[1]	Surface Hole Location	Bottom Hole Location
#1	Shawnee Fed 3268-8-41	Shawnee Fed 3268-8-11N-H	WYW-172942	NENE S8, T32N, R68W	NWNW S8, T32N, R68W
		Shawnee Fed 3268-8-12F-H	WYW-172942	NENE S8, T32N, R68W	SWNW S8, T32N, R68W
#2	Trinity Fed 3368-12-34	Trinity Fed 3368-12-E31N-H	SHL & BHL: WYW-039931	SWSE S12, T33N, R68W	NWNE S12, T33N, R68W
		Trinity Fed 3368-12-W31N-H	SHL & BHL: WYW-039931	SWSE S12, T33N, R68W	NWNE S12, T33N, R68W
		Trinity Fed 3368-12-E41N-H	SHL & Lat.: WYW-039931	SWSE S12, T33N, R68W	NENE S12, T33N, R68W
			BHL & Lat.: WYW-017902		
		Trinity Fed 3368-12-W41N-H	SHL & Lat.: WYW-039931	SWSE S12, T33N, R68W	NENE S12, T33N, R68W
			BHL & Lat.: WYW-017902		
		Trinity Fed 3368-13-E34N-H	SHL: WYW-039931	SWSE S12, T33N, R68W	SWSE S13, T33N, R68W
			Lateral: WYW-017902		
			BHL: Fee		
		Trinity Fed 3368-13-W34N-H	SHL: WYW-039931	SWSE S12, T33N, R68W	SWSE S13, T33N, R68W
			Lateral: WYW-017902		
			BHL: Fee		
		Trinity Fed 3368-13-E44N-H	SHL: WYW-039931	SWSE S12, T33N, R68W	SESE S13, T33N, R68W
			Lateral: WYW-017902		
			Lateral: WYW-005884		
			BHL: Fee		
		Trinity Fed 3368-13-W44N-H	SHL: WYW-039931	SESE S12, T33N, R68W	SESE S13, T33N, R68W
			Lateral: WYW-017902		
			Lateral: WYW-005884		
			BHL: Fee		

Well Pad Number	Well Pad Name	Well Name	Lease Numbers[1]	Surface Hole Location	Bottom Hole Location
#3	Shawnee Fee 3368-26-14 (existing)	Shawnee Fed 3368-26-21N-H	SHL: Fee	SWSW S26, T33N, R68W	NENW S26, T33N, R68W
			BHL: WYW-164646		
		Shawnee Fed 3368-35-E24N-H	SHL: Fee	SWSW S26, T33N, R68W	SESW S35, T33N, R68W
			BHL: WYW-177086		
		Shawnee Fed 3368-35-W24N-H	SHL: Fee	SWSW S26, T33N, R68W	SESW S35, T33N, R68W
			BHL: WYW-177086		

[1]SHL = Surface Hole Lease; BHL = Bottom Hole Lease

2.1.1 Drilling and Completion Well Pads

Figures 2-1 and 2-2 illustrate typical drilling and completion pad layouts. APC's anticipated initial drilling and completion pad size would range from approximately 12 to 16 acres, with an average size of 14 acres. Individual pad size would vary based on the number of wells per pad and constraints related to lease/landowner agreements, operational safety, topography, and other factors. For instance, multi-stage horizontal completions require all equipment and materials to be on location prior to beginning operations, thus increasing the overall pad size needed to accommodate these items. Also, due to the scope of activity and equipment used, sufficient space between facility placements is needed to provide operational safety. APC safety setbacks require that wells and rigs be placed entirely on the cut portion of the pad and that equipment be placed certain distances apart.

To minimize land surface disturbance, APC would aim to space wellbores 30 feet apart and to drill multiple wells consecutively from a single drilling rig, a process referred to as back-to-back completions. The back-to-back completions would occur from the same pad so that a fully-assembled drill rig could simply slide, or "skid," to the next wellbore location rather than be disassembled for transport and reassembled at the next surface hole location. The likelihood that APC could drill multiple wells with the same drilling rig back-to-back would increase as wells are drilled and additional reservoir data is gathered during the exploratory phase of the Proposed Action. However, until APC has acquired sufficient oil/gas reservoir information to determine the economic feasibility of further development and the most efficient way to recover the oil and gas reserves, APC anticipates a 6 to 12 month delay between drilling sessions. In this scenario involving a 6 to 12 month delay, 150- to 250-foot spacing would be placed between certain wells as a safety measure to allow ample space for the rig to operate while a producing well is on the same pad. For example, on a well pad containing eight wells, four wells with 30-foot spacing would be designed at each end of the pad, and 150- to 250-foot spacing would be placed in between the two sets of four wells. Regardless of well spacing, maximum surface land disturbance from the proposed Project well pads would be 16 acres per well pad. However, back-to-back completions with 30-foot well spacing would result in less surface disturbance compared to well spacing of 150 to 250 feet.

Under certain circumstances, APC would construct separate drilling and production facility pads for one well pad location. Proposed well pad #2 is designed with separate drilling and production facility pads, while the other two site-specific well pads (well pads #1 and #3) are designed with drilling and production facilities located on one well pad. In general, separating the drilling and production pads allows for the drilling and completion of the wells on one pad, and then at a later time, drilling and completion of the wells on the other pad without building additional pads. Separating the drilling and production pads allows for more reclamation of the drilling pad. Note that the future use of this two-pad

Figure 2-1: Typical Drilling and Completion Pad Layout without Large Capacity Water Storage Tank

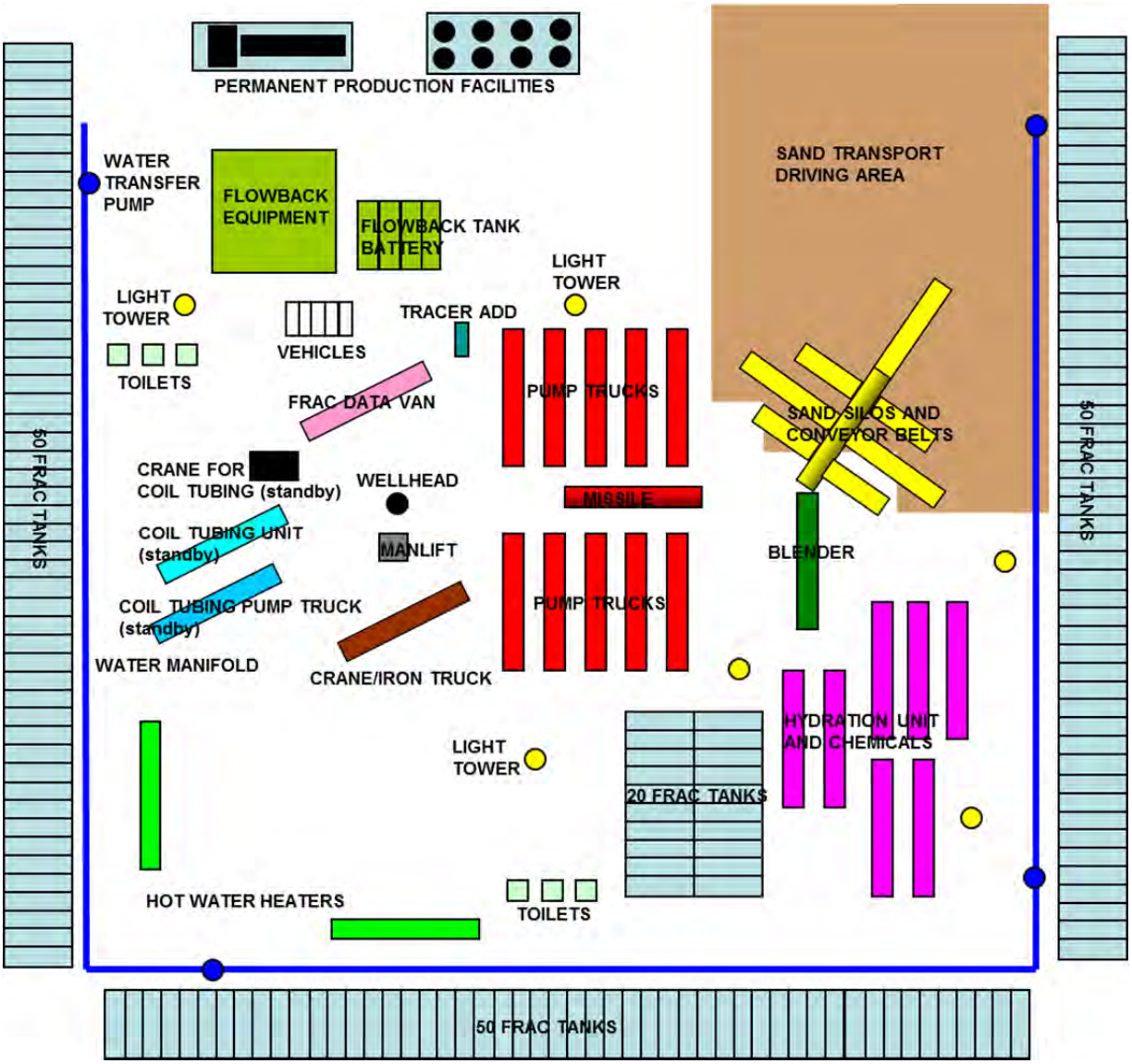
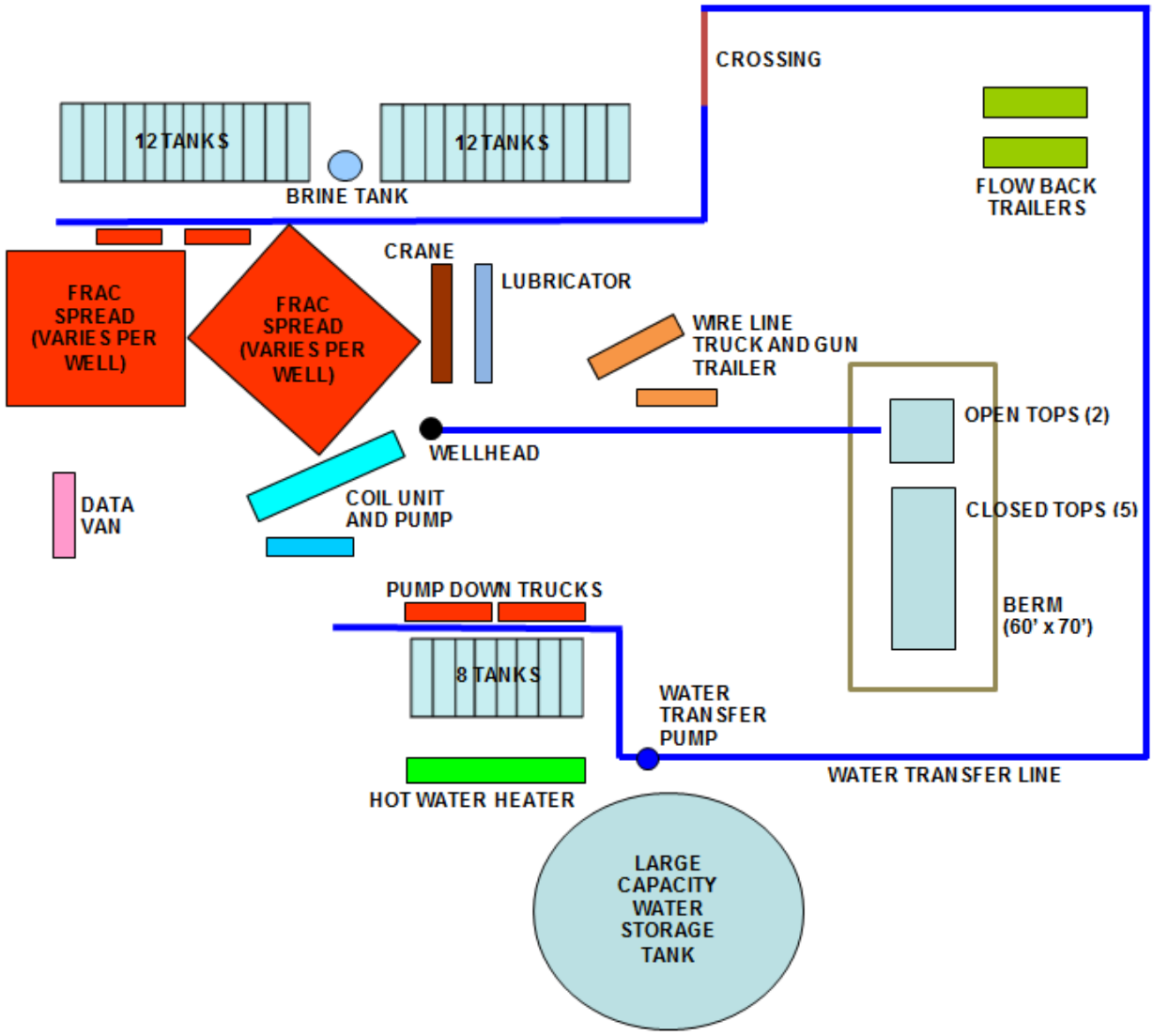


Figure 2-2: Typical Drilling and Completion Pad Layout with Large Capacity Water Storage Tank



design for the conceptual well pads (well pads #4, #5, and #6) would be dependent on lease/landowner agreements, operational safety, and topography of the specific well pad locations, once determined. Total pad size under either the single- or two-pad design would be a maximum of 16 acres.

2.1.2 Drilling, Construction, and Production Design Features

For the Proposed Action, APC expects to:

- Drill and construct an estimated 10 to 30 wells per year, completing all 32 proposed wells within 1 to 3 years. Rig availability, limitations on completion resources, timing restrictions, weather, personnel, and internal resource limitations are examples of factors that may extend the schedule for completion of the proposed wells. Weather-related delays may occur, and COAs and/or agreements with surface land owners may impose temporal restrictions.
- Develop a road network consisting of existing, improved, and new roads. APC would use the existing backbone road through the Project Area (see Figure 1-1), with upgrades to existing roads (where practicable) or construction of new roads, as needed, to access individual well pads. Access roads are discussed in greater detail in Section 2.2.3.
- Use an existing, aboveground power line network to the extent practicable, with new overhead power lines and/or buried electrical lines to each well pad.
- Consider and possibly install a centralized water supply and storage system with temporary, aboveground pipelines to well sites.
- Either install or have a third party install a natural gas transport and compression system consisting of new buried gas gathering pipelines and a centralized compression station.
- Consider and possibly install an oil and/or water gathering system, using existing infrastructure (where practicable), with new buried pipelines to each well pad.
- Locate power lines and pipelines in or immediately adjacent to new roadway disturbance or adjacent to existing roadways, where practicable.
- Maintain all engines at a decibel level below 70 decibels, as measured at the boundary of the well pad.
- Use vehicles during all phases of Project development, as shown in Table 2-4 in Section 2.1.11.

The design features listed below are intended to summarize the “typical” drilling and completion well pad for the Mohawk EA Proposed Action:

- A closed-loop drilling mud system.

- Two options for onsite water storage: (1) water tanks for use in hydraulic fracturing (referred to as "frac tanks") consisting of either 175 500-barrel (bbl) tanks (for single completion) or 250 500-bbl tanks (for back-to-back completions) (see Figure 2-1); or (2) a large capacity water tank (18,000 to 44,000 bbl) in conjunction with approximately 30 500-bbl frac tanks (see Figure 2-2).
- Ten tanks for sand and a sand transport and driving area.
- Onsite burial of cuttings in one of two fenced cuttings pits containing plastic/vinyl liners.
- Individual APDs would be completed prior to any construction for each well; these APDs would contain specific design and construction information for each well pad, explained in well-specific Surface Use Plans. See Figures 2-1 and 2-2 for a graphical representation of typical drilling and completion pad layouts with facilities.

All wellbores would be cased and cemented prior to well completion, in accordance with an approved APD and Onshore Oil and Gas Orders Nos. 2 and 7. A typical casing program consists of surface, intermediate, and production casing intervals, with each successive casing run nested within the previous. Casing setting depths are determined by a number of factors, including: presence/absence of hydrocarbons; fracture gradients; usable water zones; formation pressures; lost circulation zones; other minerals; or other unusual characteristics. After casing strings have been installed, the annular space around the outside of a casing string would be sealed using a specially formulated Portland cement mixture, or other hydraulic cement mixture, to hold the casing in place and prevent movement of fluid in this annular space. Specific casing and cementing programs would be determined during the preparation of site-specific APDs.

2.1.3 Access Roads

The Proposed Action would require a road network consisting of existing, improved, and new roads. Existing access roads in the Project Area would be maintained as necessary to accommodate appropriate year-round traffic and prevent unnecessary erosion by maintaining proper crown and ditching.

The Proposed Action would also require upgrades to existing roads or construction of additional new roads as needed to access well pads. All upgraded and new roads would be engineered to meet BLM road design standards. As necessary for safe access, existing roads may be improved by grading, widening, gravel surfacing, cattle guard replacement, drainage control maintenance or improvement, erosion control installation, topsoil stripping, turnout additions, and replacement or addition of drainage relief culverts. The Proposed Action would require upgrades (i.e., widening) of approximately 5 miles of existing roads in the Project Area (1.96 miles for the site-specific wells and approximately 3 miles for the conceptual wells). Where existing roads need to be widened, ditches and surfacing would be pushed out to facilitate

the passage of Project equipment. It is estimated that an additional 20 feet of disturbance would be required to widen existing roads, resulting in a total disturbance of approximately 12 acres within the Project Area. Reclamation of these upgraded road segments to their original widths would result in the same amount of long-term disturbance as existing (i.e., pre-Proposed Action) disturbance.

Access to the six well pads would require the construction of approximately 2 miles, total, of new access roads (0.83 mile for the site-specific wells and approximately 1.5 miles for the conceptual wells). Based on a typical 60-foot initial disturbance width for new roads, approximately 17 acres of initial disturbance would occur. Following the initial disturbance, the margins of the roadway would be reclaimed, resulting in a long-term disturbance width of 45 feet, which would result in approximately 13 acres of long-term disturbance from new roads. Whenever practicable, roads would be designed and constructed to disturb less than the 60-foot initial disturbance width. This could potentially be accomplished through the incorporation of additional turnouts or design features, provided that traffic and safety concerns are satisfied.

Well access road design characteristics would vary based on terrain, but would typically consist of a compacted road base surfaced with gravel, unless precluded by land conditions or surface owner agreements. The 20-foot wide gravel driving surface would be supported by a 24-foot wide sub-grade and flanked by 10-foot wide ditched slopes on one or both sides. The driving surface would have a minimum road rise of 5 to 8 percent above the original surface. Precise road dimensions would be supplied with individual well plats in the site-specific APD. Access roadways would be built to be permanent and would remain in place for at least the productive life of each respective well. Temporary roadways required for the construction of facilities would be reclaimed as soon as practicable.

Gravel used on well access roads would be obtained from a permitted commercial gravel supplier in the area and would be identified in the APD. To mitigate potential health concerns, suppliers would be asked to provide erionite-free gravel for use in the Project Area. APC would not construct new well access roads in conjunction with gravel transport.

2.1.4 Power Lines

APC would request that the local electric utility company install overhead lines and “drop” power at several locations in the Project Area. APC would then route power from these drop points (via underground distribution lines) to each individual well location within the Project Area. Buried lines would follow existing access roads to the extent practicable to minimize new disturbances. All distribution lines installed by APC along access roads would be buried in a trench on the opposite side of

the road from buried gas lines, and would require an initial disturbance width of approximately 20 feet, to be reclaimed in full once construction has been completed. The installation of overhead lines would result in an initial disturbance width of approximately 30 feet to accommodate pole placement, stringing of the lines, and vegetation clearing within the right-of-way (ROW) for the line. Subsequent reclamation would result in long-term disturbance of approximately 30 percent of the initial disturbance.

It is assumed that the Proposed Action would require approximately 9 miles of overhead power lines (1.5 miles for each of the six well pads) and 1,200 feet of buried power lines (200 feet for each of the six well pads). Installation of these power lines would result in a total initial disturbance of approximately 33 acres within the Project Area and a long-term disturbance of approximately 10 acres within the Project Area. These disturbance estimates assume that new ROW would be required for the entire length of these power lines. However, it is likely that some of the power lines could be installed within a shared ROW with upgraded or new roads, and, therefore, actual disturbance would be less than these estimates.

2.1.5 Drilling and Completion Water Sources, Amounts, and Disposal

While exact quantities of water used would vary, APC estimates that drilling and completion for each well would require between approximately 80,000 and 100,000 bbls[2] of water. In addition, APC estimates that approximately 0.028 gallons of water per square foot per day would be required for dust abatement, based on WOGCC road watering permits for other APC projects in the region. APC proposes to obtain water for drilling and completions from the Shawnee water load out facility/staging area (located in NENW, Section 9, Township 32N, Range 68W) for the site-specific wells (well pads #1, #2, and #3). Municipal water from Buffalo or Gillette may also be used for cementing. The specific source of water to be used in drilling operations for each of the conceptual wells (well pads #4, #5, and #6) would be identified at the time of APD submittal. APC would potentially install a centralized water storage facility within the Project Area. Water transportation methods from either a central water storage facility or the water source would include temporary aboveground water lines from the water source or storage location to the well location or haul trucks from the water source or storage location to the well location using existing roads.

2.1.6 Completion

Once a well has been drilled and cased, completion operations would commence. These completion operations would typically consist of cleaning out the wellbore, pressure testing the casing, perforating

[2] One fluid bbl of water equals 31.5 gallons.

and hydraulic fracturing in the horizontal portion of the hole, and running production tubing in the event that commercial production is established.

In conjunction with these completion operations, APC would hydraulically fracture selected intervals within the targeted formation in order to "stimulate" production. These hydraulic fracturing operations would typically consist of pumping a thick fluid mixture consisting of 99.5 percent sand and water into the down hole under pressure. Various chemical additives are added to the fracturing fluids to improve performance. The mixture is then pumped through the perforations, or ports, into the rock formation. As the formation is fractured, the resultant fissures (fractures) are filled with sand which props them open and facilitates the flow of oil/gas into the wellbore and subsequently to the surface. For those horizontal wells drilled, APC would conduct these completion operations on the entire length of the lateral (horizontal wellbore) in stages commencing at the end of the wellbore (bottom hole location) and working backwards to the beginning of the lateral section. The WOGCC requires operators to disclose the types and amounts of hydraulic fracturing chemicals that will be used (WOGCC Rules and Regulations, Chapter 3 § 45(d)). For additional information on hydraulic fracturing, including a list of APC's hydraulically fractured wells, reference the national hydraulic fracturing chemical registry at *fracfocus.org*. Additional information on the hydraulic fracturing process is provided in Appendix A of the East Converse EA (WY-060-EA12-227) (BLM, 2012).

Upon completion of the hydraulic fracturing operation, the well would be flowed back to the surface through temporary production equipment in an attempt to recover as much of the hydraulic fracturing fluids as practicable, and to clean excess sand out of the lateral prior to setting production equipment and commencing production of oil and gas. All fluids returned during the flow-back procedure would be captured in steel tanks situated on the well pad; flowback would occur at a rate of approximately 42 gallons per minute over a period of approximately 20 days. These recaptured fluids would subsequently be transferred to 500 gallon trucks and transferred offsite by a professional disposal service in strict accordance with both BLM and WOGCC rules and regulations applicable thereto. All flowback fluids captured after the approximate 20-day period would be considered produced water. APC's analysis of flow-back fluids from the nearby Table Mountain horizontal well (TMFU 4577-23-11H) concluded that approximately 25 percent of the fluid injected into the well during the hydraulic fracturing process is recovered within this initial 20-day flow-back period. For this Proposed Action, similar storage and disposal methods would be used to process produced water, which may be of limited quantity.

APC is currently investigating alternatives for the recycling and re-use of flowback and produced water through pilot programs in other assets and basins. If technologically and economically viable alternatives

emerge, water recycling technologies may be implemented in the Project Area. Potential recycling options include the use of produced water from both coal bed natural gas (CBNG) and deep oil wells as a completion water source for use during hydraulic fracturing, or as a source of make-up water for water injection wells. For example, a recently approved sundry allows APC to inject produced water from well TMFU 4577-23-11H in nearby Johnson County into the Culp Draw or Table Mountain injection systems rather than trucking it to a disposal well or evaporation ponds (WOGCC, 2012). The recycled produced water will help make up shortfalls for these water injection systems, which currently do not receive sufficient volumes of produced water from their respective fields. Therefore, the need to augment these water floods with fresh water sources would be reduced.

Since produced water from the proposed wells is anticipated to be of limited quantity, its use would depend on the rate, volume, and quality of water generated. Unless APC seeks and is granted approval to recycle water from the proposed wells, all produced water would be stored in tanks onsite and then hauled to a permitted disposal facility. Specific disposal sites would be identified after well completion in accordance with Onshore Oil and Gas Order No. 7.

2.1.7 Pipelines

Under full field development, APC expects that gas sales from these wells would be accomplished through the installation of a gas gathering system within the overall Project Area by a third party. The third-party gas gathering system would be designed to gather the natural gas produced from each individual well, transport the gas to a main trunk line, and then transport the gas to various compression and processing facilities. Due to the exploratory nature of the proposed wells, there is a high level of uncertainty in predicting the expected rate of gas production. If sufficient volumes are present, some of the gas produced may be used to power equipment on the well location, including the heater-treater, pumping unit, and a temporary electrical generator necessary to power the pumping unit and portable lease automatic custody transfer (LACT) unit, which is required by the BLM Authorizing Officer (AO) for oil measurement and royalty accounting purposes. The remaining gas would be metered on lease for royalty accounting purposes and would then be introduced into the third-party gas gathering system for sales.

New gas gathering pipelines would likely consist of buried 3- to 6-inch steel and/or high-density polyethylene laterals to gather the gas from each individual well location and transport the gas to the main 6-inch to 24-inch trunk line. These gathering lines would be installed in a 75-foot ROW adjacent to existing road(s) where practicable, or in a common ROW for new or upgraded roads (no new surface disturbance). Where paralleling an access road is not feasible, cross-country lines would be used to

connect with the main trunk line. The construction of a ditch with a width of 1 to 2 feet and a depth of 4 to 5 feet to install these cross-country lines would require a disturbed ROW width of 75 feet. All surface disturbances resulting from pipeline installation would be subsequently reclaimed, resulting in limited long-term disturbance. Based on production rates, APC would install appropriately sized compressor station(s) in the Project Area to facilitate the flow of gas from individual wells to a third party tie-in point.

For purposes of estimating surface disturbance for the Proposed Action, it is assumed that approximately 9 miles of pipeline (1.5 miles for each of the six well pads) would be required in the Project Area, resulting in a total initial disturbance of approximately 82 acres. In addition, one 5-acre compressor station would be required within the Project Area to support the Proposed Action. Complete reclamation in the long-term is assumed for buried pipelines. Approximately 5 acres would remain as disturbance in the long-term for the compressor station.

Additional pipelines could be installed by APC or a third party in a similar fashion to gather oil and produced water (depending on the rate and overall volume of their production). In addition to using suitable existing infrastructure, it is possible that these systems could, where practicable, be installed simultaneously with gas lines, thereby limiting surface disturbance along trunk lines and laterals.

2.1.8 Drilling and Completion Sequence

Based on experience with other horizontal drilling and completion operations, APC anticipates the timing and sequencing shown in Table 2-2. These durations would vary based on factors at each well location. APC anticipates that drilling and construction would proceed at a rate of 10 to 30 wells per year, with all wells completed within 1 to 3 years.

Table 2-2: Anticipated Drilling and Completion Sequence and Timing (Per Well)

Drilling and Completion Step	Approximate Duration
Build location (roads, pad, and other initial infrastructure)	30 days
Rig mobilization	2-4 days[1]
Drilling (24/7)	30 days
Schedule/logistics for completion	30 days
Completion (setup, completion, demobilization)	5-8 days

[1]Depending on distance and need to add supplemental drilling equipment, such as skidding plates.

2.1.9 Production

Production equipment required on the individual well locations would typically include, but not be limited to, the following:

- A pumping unit would be installed at the well head to provide power for each individual well. The make and model of the installed pumping unit would be determined based on availability during the flowback period after the well has been completed. Electrically powered Jet Pump (typical dimensions: 30 feet wide by 100 feet long by 8 feet high) and/or Rod Pump (pumpjack) (typical dimensions: 8 feet wide by 49 feet long by 35 feet high) units would typically be used, or in rare instances, a gas-powered artificial lift would be used. The pumping unit would be enclosed with safety guards and meet Occupational Safety and Health Administration (OSHA) requirements;
- A portable LACT unit for each individual well;
- A 6-foot by 20-foot horizontal or vertical heater-treater with at least 750,000 British Thermal Unit (Btu) burner per well;
- A 30-inch by 10-foot two-phase vertical separator for each individual well;
- A tank battery, which would generally consist of eight 400-bbl steel oil tanks per well. These tanks would typically all be located together and would be isolated for each particular well with a LACT unit to prevent the commingling of oil produced from each individual well, as required by the BLM AO;
- An oil recirculating pump with an electric motor;
- A 48-inch emission control device for tank volatile organic compounds (VOCs);
- A 4-inch flare stack to temporarily burn produced gas; and,
- A meter utilizing electronic flow measurement (EFM) with automation from a BLM field office for gas sales from each individual wellbore if/where applicable.

All permanent aboveground production facilities installed on the producing well locations would be painted one of the standard environmental colors recommended by the Rocky Mountain Five-State Interagency Committee and to be selected at the discretion of the BLM. A dike or berm would be constructed completely around those production facilities designed to hold fluids (e.g., production tanks and heater-treater).

2.1.10 Interim and Final Reclamation

Sufficient topsoil to facilitate revegetation would be segregated from subsoil materials during construction activities and stockpiled for future reclamation of the disturbed areas. The salvaged topsoil would be evenly distributed over those disturbed surfaces subject to reclamation upon termination of drilling and completion operations, as part of the reclamation and revegetation program. Topsoil

stockpiles would be stabilized with vegetation until used for reclamation purposes as necessary or as required by either the private surface land owner or the BLM.

All disturbed surfaces would be reclaimed as soon as practicable after the initial disturbance.

- Approximately 50 percent (4 to 6 acres) of the original 8- to 12-acre equipment-containing well pad would be required for long-term production operations. The remaining area of the initial well pad disturbance would be reclaimed primarily through backfilling the cuttings pits, leveling and recontouring of "non-working" disturbed areas, redistribution of stockpiled topsoil over these disturbed areas, installation of erosion control measures, and reseeding as recommended by the BLM and/or private surface land owner. Seeding would occur in the next appropriate seeding season following the completion of surface disturbing activities, generally within 180 days of completion of the last well on the pad. In the fall, seeding would take place after September 15th and prior to ground frost; in the spring, seeding would take place after the frost has left the ground and prior to May 15th.
- The central water storage facility would be a temporary facility (2-3 years). Once constructed, disturbed areas not utilized for water storage or support facilities would be stabilized and reclaimed while the facility is in use. Once the facility is no longer needed, the site would be reclaimed per the surface owner's requirements. It is anticipated that the majority of the site would be reclaimed, and approximately 1 acre of surface disturbance would occur in the long-term where a single well and drive-around road would remain.
- Solidification and subsequent reclamation of the cuttings pits would be accomplished as soon as practicable following well completion. Cuttings pits would be backfilled immediately upon completion of the solidification process.
- Immediately following road construction, stockpiled topsoil would be evenly redistributed over the road embankment and borrow ditch slopes. These areas would be stabilized and reclaimed with the approved seed mix as soon as practicable in the next appropriate seeding season, as discussed above.
- Pipeline ROW disturbance areas would be completely reseeded as soon as practicable in the next appropriate seeding season in accordance with the seeding recommendations obtained from either the private surface land owner or the BLM, as appropriate.
- Prior to reseeding, compacted areas would be scarified by ripping or chiseling to loosen compacted soils, where underlying material would not significantly degrade topsoil.

2.1.11 Vehicle Traffic

APC estimates that vehicle traffic (one-way trips) would be as shown in Table 2-3.

Table 2-3: Vehicle Traffic Estimate for a Typical Well under the Proposed Action

Phase of Development	Average Daily Trips Per Well[1]	Total Trips Per Well
Pre-Construction Activities	19	320
Drilling Activities	44	1,112
Completion Activities	160	1,778
Production and Operation Activities	4	29,565[2]

[1]Represents an average number of vehicle trips associated with operational support; vehicle traffic estimates do not include rig move in or out.

[2]Includes oil transport of 4 one-way trips per day for the first 6 months, and 2 one-way trips per day for the remainder of the estimated 40-year operational life of the well. Since produced water generated from the proposed wells is anticipated to be minimal, trips associated with produced water disposal or recycling are not included in these estimates. The number of production and operation trips may be reduced for multi-well pads by combining trips.

2.1.12 Waste and Hazardous Materials Management

A closed loop fluid handling system would be used during drilling; thus, there would be no reserve pit in the typical sense. Drilling fluids would be contained in aboveground steel tanks. The closed loop system would use mechanical aids for the separation of drilling fluids into liquids and solids. Liquids would be recycled into the mud system once they are cleaned of cuttings. Liquid hydrocarbons produced during completions operations would be captured and placed in test tanks on the well pad, then later sold.

Solids (drill cuttings) would be contained in a lined cuttings-collection area that would be located at least 30 feet from a well and designed to prevent the collection of surface runoff from a well pad and surrounding area. No trash would be placed or disposed of in the cuttings collection area. The cuttings-collection area would be generally aboveground with 2- to 3-foot-high berms. If a below-grade cuttings-collection area were constructed, a minimum of 2 feet of freeboard would be maintained during operations; it would be fenced for personnel, wildlife, and livestock safety, and fencing would be maintained around the cuttings-collection area until reclaimed (closed).

Drill cuttings would be tested and handled according to approved methods, which may include:

- Offsite disposal at an approved disposal site,
- In-situ burial,
- Transfer and burial in the cuttings-remediation area,

- Bio-remediated with Eco-Sponge™ (or other approved remediation product) and incorporated into the pad or used for reclamation, or
- Remediated through the use of WOGCC-approved hydrogen peroxide oxidation.

The specific cuttings collection and burial areas on the well pad sites would be determined at the time of APD submittal. If buried, cuttings would need to meet State of Wyoming requirements for cuttings burial.

Portable, self-contained chemical toilets would be provided onsite for human waste. Upon completion of operations, or as required, the toilet holding tanks would be pumped and the contents disposed of at a permitted sewage disposal facility. Sewage disposal would follow Wyoming Department of Environmental Quality (WDEQ) rules and regulations.

Solid waste and debris would be contained in portable trash enclosures. Solid waste would be disposed of at a WDEQ-approved sanitary landfill as needed or upon completion of operations. Materials not able to be contained in trash enclosures would be removed from the well location and properly disposed. No potentially adverse materials or substances would be left at the location.

Used motor oil (change oil) would be placed in closed containers and disposed of at an authorized disposal site.

APC and its contractors would comply with applicable federal laws and regulations regarding the handling and storage of hazardous substances used for drilling and completions. Necessary hazardous materials would be stored on the well pad. Releases (i.e., leaks and spills) of hazardous substances in excess of reportable quantities, as established by 40 CFR Part 117, would be reported as required by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980, as amended. A copy of the report would also be furnished to BLM and other appropriate federal and State agencies.

APC would maintain at the well locations and in APC's Gillette office the Material Safety Data Sheets (MSDS) for chemicals, compounds, and substances used for production. MSDS for applicable materials used for construction, drilling, and completion activities undertaken by contractors would be the responsibility of the contractors per the Emergency Planning and Community Right-to-Know Act (EPCRA). The contractors would maintain these MSDS at their offices and onsite.

APC and its contractors shall require that use, production, storage, transport, and disposal of hazardous materials associated with Project operations and drilling, completion, and production of wells follow

applicable existing or hereafter promulgated federal, State, and local government rules, regulations, and guidelines.

2.1.13 Surface Disturbance Summary

The construction activities described in the sections above and summarized in Table 2-4 represent the standard activities the proponent anticipates for the Proposed Action. Where an area or distance is given for the site-specific well pads, the numbers represent the anticipated disturbance based on current design. Where an area or distance is given for the conceptual well pads, these numbers represent the anticipated maximum disturbance area across all well locations and may, therefore, vary at individual locations as a result of resource constraints, topography, or engineering factors. Construction activities for each proposed well location and associated infrastructure would follow practices and procedures outlined in subsequent individual APDs and any COAs appended thereto by the BLM. In addition, access road and well pad construction activities for each proposed well location would follow guidelines and standards as set forth in the joint BLM/U.S. Forest Service (USFS) publication: *Surface Operating Standards for Oil and Gas Exploration and Development (Fourth Edition)* and/or the contractual requirements of any affected private (fee) surface land owner(s).

Table 2-4: Summary of Surface Disturbance from the Proposed Action

	Initial Surface Disturbance							Post Interim Reclamation Surface Disturbance						
	Well Pad	**Separate Production Pad**	**New Access Roads[1]**	**Upgrade Existing Roads[2]**	**Pipelines and Compressor Station[3]**	**Power Lines[4]**	**Central Water Storage Facility**	**Well Pad**	**Separate Production Pad**	**New Access Roads[5]**	**Upgrade Existing Roads[6]**	**Pipelines and Compressor Station[7]**	**Power Lines[8]**	**Central Water Storage Facility**
Well pad #1	12.77 acres	N/A	1.78 acres (0.25 miles)	0 acres (0 miles)	13.64 acres (1.50 miles)	5.55 acres (1.54 miles)	12.00 acres	4.45 acres	N/A	1.34 acres (0.25 miles)	0 acres	0 acres	1.64 acres (1.50 miles)	1.00 acre
Well pad #2	10.80 acres	4.45 acres	2.55 acres (0.35 miles)	0.78 acres (0.32 miles)	13.64 acres (1.50 miles)	5.55 acres (1.54 miles)		2.09 acres	2.98 acres	1.92 acres (0.35 miles)	0 acres	0 acres	1.64 acres (1.50 miles)	
Well pad #3 (pre-existing)	13.20 acres	N/A	1.67 acres (0.23 miles)	3.97 acres (1.64 miles)	13.64 acres (1.50 miles)	5.55 acres (1.54 miles)		5.20 acres	N/A	1.26 acres (0.23 miles)	0 acres	0 acres	1.64 acres (1.50 miles)	
Well pad #4[9]	16.00 acres		3.64 acres (0.50 miles)	2.42 acres (1.00 miles)	13.64 acres (1.50 miles)	5.55 acres (1.54 miles)		6.00 acres		2.73 acres (0.50 miles)	0 acres	0 acres	1.64 acres (1.50 miles)	
Well pad #5[9]	16.00 acres		3.64 acres (0.50 miles)	2.42 acres (1.00 miles)	13.64 acres (1.50 miles)	5.55 acres (1.54 miles)		6.00 acres		2.73 acres (0.50 miles)	0 acres	0 acres	1.64 acres (1.50 miles)	
Well pad #6[9]	16.00 acres		3.64 acres (0.50 miles)	2.42 acres (1.00 miles)	13.64 acres (1.50 miles)	5.55 acres (1.54 miles)		6.00 acres		2.73 acres (0.50 miles)	0 acres	0 acres	1.64 acres (1.50 miles)	
Proposed Action Alternative Totals:	89.22 acres		16.92 acres (2.33 miles)	12.01 acres (4.96 miles)	86.84 acres (9.00 miles)	33.30 acres (9.24 miles)	12.00 acres	32.72 acres		12.71 acres (2.33 miles)	0 acres	5.00 acres	9.84 acres (9.00 miles)	1.00 acre
	Total short-term surface disturbance: 250.29 acres (225.90 acres new; 24.39 acres pre-existing[10])							Total long-term surface disturbance: 61.27 acres						

[1]Assumes a 60-foot-wide initial road disturbance width.

[2]Assumes 20 feet of additional (new) disturbance needed to upgrade/widen road.

[3]Pipeline lengths and surface disturbance estimates are conceptual for all well pads. Assumes a 75-foot-wide initial pipeline disturbance width. Assumes one 5-acre compressor station within the Project Area.

[4]Power line lengths and surface disturbance estimates are conceptual for all well pads. Assumes 1.5 miles of overhead power lines and 200 feet of buried power lines per well pad. Assumes a 30-foot-wide initial disturbance width for overhead power lines and a 20-foot-wide initial disturbance width for buried power lines.

[5]Assumes a 45-foot-wide post interim road disturbance width.

[6]Complete reclamation in the long-term is assumed for disturbance resulting from upgrading existing roads.

[7]Complete reclamation in the long-term is assumed for pipelines. Assumes one 5-acre compressor station would remain as disturbance for the life of the Project.

[8]Complete reclamation in the long-term is assumed for buried power lines. Assumes long-term disturbance for overhead power lines is 30 percent of initial disturbance.

[9]Eststimated disturbance values provided for conceptual well pads #4, #5, and #6 are based on values anticipated for typical well pad development in the Project Area.

[10]Surface disturbance for the well pad, new and upgraded roads, and power lines is assumed to be pre-existing for well pad #3.

2.2 No Action Alternative

Under the No Action Alternative, the currently proposed 32 new wells within the Project Area would not be approved at this time. Federal oil and gas mineral resources throughout the Project Area would continue to be available for leasing, exploration, and development. NOSs, APDs, and Plans of Development (PODs) would require individual NEPA analyses on a case-by-case basis, where valid and existing lease rights occur.

2.3 Applicant-Committed Environmental Protection Measures

APC incorporated several design features, best management practices (BMPs), and conservation measures into the Proposed Action in order to alleviate resource impacts. Project activities would also follow practices and procedures outlined in the Casper RMP/ROD, each individual APD, and any COAs appended by the BLM.

2.3.1 Mitigation Measures

APC has committed to the implementation of the mitigation measures listed in Appendix A – Applicant Committed Measures and Appendix B – the Master Integrated Pest Management Plan in the Project Area. These applicant-committed measures are integrated into the Proposed Action, and the effects of these measures are incorporated into the analysis in this document.

2.3.2 Site-Specific Onsite Commitments

APC, BLM, and contractors conducted pre-approval onsite reconnaissance of the proposed site-specific well pad and access road locations. Table 2-5 describes issues that were resolved during the onsite reconnaissance at each location. New locations for roads or pads that were moved during the NOS stage are analyzed in this EA.

Table 2-5: Issues Addressed during Onsite Reconnaissance of Site-Specific Well Pads

Well Pad #	Well Pad Name	Issues Addressed
#1	Shawnee Fed 3268-8-41	No issues.
#2	Trinity Fed 3368-12-34	Need barrier (e.g., dirt berm or pipe rail) between well pad site and existing road to enhance safety.
#3	Shawnee Fee 3368-26-14	Sage grouse lek and raptor nest stipulations would apply.

3.0 AFFECTED ENVIRONMENT

This section briefly describes the physical and regulatory environment affected by the alternatives in Section 2.0. Only those resources that would potentially be impacted by the Proposed Action are discussed in detail.

The general Project Area is located in eastern Converse County, approximately 15 miles east of Douglas, Wyoming. The topography consists of rolling uplands and low ridges, dissected by numerous tributary drainages. The Project Area is generally sagebrush grassland and ponderosa pine forest. The Project would take place in the Pine Scoria Hills Level IV ecoregion, part of the overall Northwestern Great Plains Level III ecoregion as defined by the U.S. Environmental Protection Agency (EPA) (Chapman et al., 2004). This area is distinguished from the surrounding Powder River Basin grasslands by an open ponderosa pine-juniper vegetation type. The hills are capped with a distinctive red-orange rock. Elevations within the Project Area range from approximately 4,900 to 5,500 feet above mean sea level. The area is on a watershed divide, draining to both the North Platte River to the south and Niobrara River to the north. Livestock grazing is the primary historic land use in the area. Current land uses include livestock grazing and scattered oil/gas development.

3.1 Air Resources

This EA incorporates an analysis of the contributions of the proposed Project to greenhouse gas (GHG) emissions and a general discussion of potential impacts to climate. Air resources include climate, climate change, air quality, air quality-related values (AQRV) (including visibility and atmospheric deposition), noise, and smoke management. This EA analyzes the potential effects of BLM and BLM-authorized activities on air resources as part of the planning and decision-making process.

3.1.1 Climate Change and Greenhouse Gases

A growing body of evidence indicates that Earth’s atmosphere is warming. Records show that surface temperatures in the Wyoming region have risen approximately 1.5 degrees Fahrenheit (°F) since the 1960 to 1979 baseline years (Global Change Research Program, 2009). The largest increase in average temperature has occurred in the winter months in the northern portions of the region. Relatively cold days in the region are becoming less frequent and relatively hot days are becoming more frequent (Global Change Research Program, 2009). Observed changes in oceans, ecosystems, and ice cover are consistent with this warming trend (National Academy of Sciences, 2006).

Ongoing scientific research has identified the potential impacts of GHG emissions, including carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), water vapor, and several trace gases, on global climate change. Through complex interactions at regional and global scales, these GHG emissions cause a net warming of the atmosphere (the atmosphere makes surface temperatures suitable for life on Earth), primarily by decreasing the amount of heat energy Earth radiates back into space. Although GHG concentrations in the atmosphere and climatic conditions have varied throughout Earth's history, recent industrialization and burning of fossil fuels has caused global atmospheric CO_2 concentration to increase dramatically; this most recent CO_2 increase is likely to contribute to overall climatic changes (National Academy of Sciences, 2006).

Global atmospheric concentrations of CO_2, CH_4, and N_2O have increased markedly as a result of human activities since 1750 and now far exceed pre-industrial values (as determined from ice cores spanning many thousands of years). The global increase in CO_2 concentrations is due primarily to fossil fuel use and land use change, while those of CH_4 and N_2O are due to agricultural soil management, animal manure management, sewage treatment, and mobile and stationary combustion of fossil fuels (Intergovernmental Panel on Climate Change, 2007; EPA, 2013).

According to climate change researchers, the effects of climate change are expected to vary by region, season, and time of day (National Academy of Sciences, 2006; Global Change Research Program, 2009). Computer model forecasts indicate that increases in temperature will not be evenly or equally distributed, but are likely to be accentuated at higher latitudes. Warming during winter is expected to be greater than during the summer, and increases in daily minimum temperatures are more likely than increases in daily maximum temperatures (National Academy of Sciences, 2006). Within a given region, increasing temperatures also could affect the amount of water vapor in the atmosphere, the timing and amount of precipitation, the intensity of storm systems, snow melt, and soil moisture. All of these factors can affect climate, day-to-day weather conditions, plant physiology, and air quality in the planning area.

Based on research compiled for the International Panel on Climate Change Fourth Assessment Report, 2007 (Intergovernmental Panel on Climate Change, 2007), potential effects of climate change on resources in the affected environment are likely to be varied. Within North America, the report specifically forecasts that: warming in western mountains is projected to cause decreased snowpack, more winter flooding and reduced summer flows, exacerbating competition for over-allocated water resources; in the early decades of the century, moderate climate change is projected to increase aggregate yields of rain-fed agriculture by 5 to 20 percent, but with important variability among regions; major challenges are projected for crops that are near the warm end of their suitable range or which depend on highly utilized

water resources; cities that currently experience heat waves are expected to be further challenged by an increased number, intensity, and duration of heat waves during the course of the century, with potential for adverse health impacts; and coastal communities and habitats will be increasingly stressed by climate change impacts interacting with development and pollution.

Specific modeling and/or assessments of the potential effects for the Project Area and for the State of Wyoming currently do not exist; however, there are downscaled models that can be applied such as the Northwestern Plains Rapid Ecoregional Assessment (REA) and the 2014 National Climate Assessment (http://nca2014.globalchange.gov/report/regions/great-plains).

In 2012, the Northwestern REA presented the results of the climate change analysis for this ecoregion. The analysis is presented as a series of figures generated using the RegCM3 15-km pixel regional climate change model data. The figures that are included depict the current or baseline period (1980 to 1999).

The general precipitation pattern is presented on Figure 3-1. The general annual average precipitation pattern for the Northwestern Plains ecoregion is a trend of increasing precipitation from the northwest to the southeast. This trend is not present in the November to February period and is less apparent during the warm rainy season in May and June. The Powder River Basin southwest of the Black Hills is another exception as it is relatively drier than the southeastern area of the ecoregion.

The mean annual temperature for existing climate pattern in the Northwestern Plains is presented on Figure 3-2. The climate change model indicates that the southeastern corner of the Northwestern Plains is generally warmer than the rest of the ecoregion. The model shows an exception in south central Montana that is slightly warmer than the surrounding areas during the November to February season.

The National Climate Assessment (NCA) released on May 5, 2014, updates the baseline period (1981-2010) for precipitation and temperature. The NCA portrays similar baseline conditions that the REA shows.

All of North America is likely to experience an increase in average temperature during the next 100 years, and annual mean warming is likely to exceed global mean warming in most areas (Intergovernmental Panel on Climate Change, 2007). Temperatures in the planning area are projected to increase substantially by the end of this century (Global Change Research Program, 2009). Summer temperatures in the planning area are expected to increase between approximately 7°F and 10+°F by 2080 to 2099. Overall, temperature in the region that includes the planning area is projected to increase between 2.5°F to more than 13°F compared to the 1960 to 1979 baseline, depending on future GHG emissions (Global Change

Figure 3-1: Current (1980-1999) Total Annual Precipitation (Millimeters)

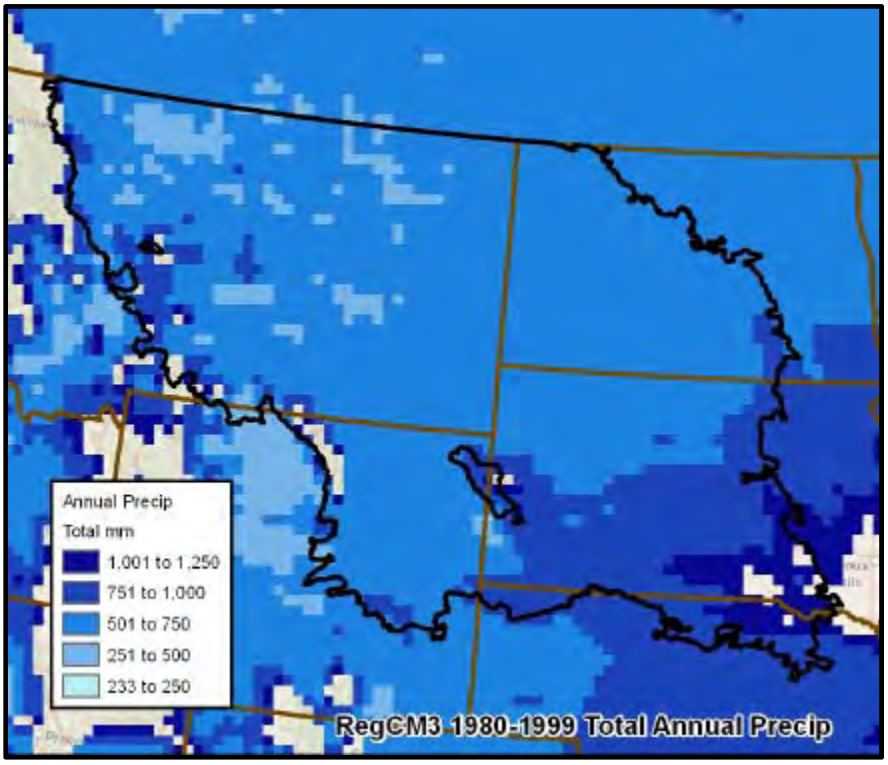
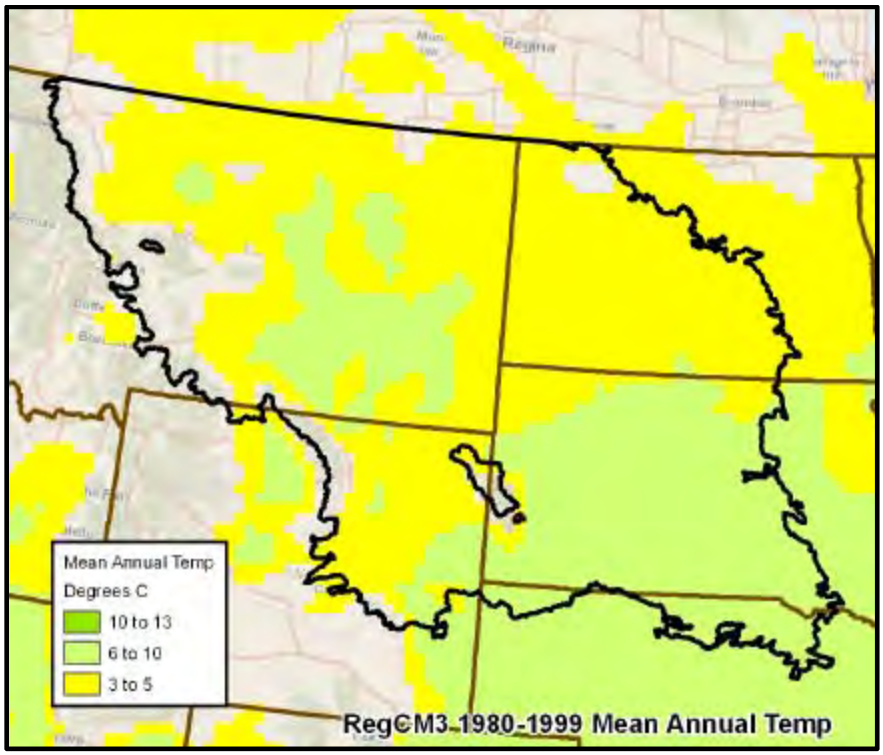


Figure 3-2: Current (1980-1999) Mean Annual Temperature (Degrees Celsius)



Research Program 2009). This range of temperature increase reflects the current uncertainty in climate change modeling and represents the likely range of model projections, although lower or higher outcomes are possible.

Increasing temperatures in the planning area are likely to contribute to increased evaporation, drought frequencies, and declining water quantity. The warming of lakes and rivers will adversely affect the thermal structure and water quality of hydrological systems, which will add additional stress to water resources in the region (Intergovernmental Panel on Climate Change, 2007). The planning area depends on temperature-sensitive springtime snowpack to meet demand for water from municipal, industrial, agricultural, recreational uses, and BLM-authorized activities. The U.S. Geological Survey (USGS) notes that mountain ecosystems in the western United States are particularly sensitive to climate change, especially in the higher elevations, where much of the snowpack occurs, which have experienced three times the global average temperature increase over the past century (USGS, 2010). Higher temperatures are causing more winter precipitation to fall as rain rather than snow, which contributes to earlier snowmelt. Additional declines in snowmelt associated with climate change are projected, which would reduce the amount of water available during summer (Global Change Research Program, 2009). Rapid spring snowmelt due to sudden and unseasonal temperature increases can also lead to greater erosive events and unstable soil conditions.

Increases in average summer temperatures and earlier spring snowmelt in the planning area are expected to increase the risk of wildfires by increasing summer moisture deficits (Global Change Research Program, 2009). Studies have shown that earlier snowmelts can lead to a longer dry season, which increases the incidence of catastrophic fire (Westerling et al., 2006). Together with historic changes in land use, climate change is anticipated to increase the occurrence of wildfire throughout the western United States.

There is evidence that recent warming is impacting terrestrial and aquatic biological systems (Intergovernmental Panel on Climate Change, 2007). Warming temperatures are leading to earlier timing of spring events such as leaf-unfolding, bird migration, and egg-laying (Intergovernmental Panel on Climate Change, 2007). The range of many plant and animal species has shifted poleward and to higher elevation, as the climate of these species' traditional habitat changes. As future changes in climate are projected to be even greater than those in the recent past, there will likely be even larger range shifts in the coming decades (Lawler et al., 2009). Warming temperatures are also linked to earlier "greening" of vegetation in the spring and longer thermal growing seasons (Intergovernmental Panel on Climate Change, 2007). In aquatic habitats, increases in algal abundance in high-altitude lakes have been linked to

warmer temperatures, while range changes and earlier fish migrations in rivers have also been observed (Intergovernmental Panel on Climate Change, 2007). Climate change is likely to combine with other human-induced stress to further increase the vulnerability of ecosystems to other pests, invasive species, and loss of native species. Climate change is likely to affect breeding patterns, water and food supply, and habitat availability to some degree. Sensitive species in the , such as the greater sage-grouse, which are already stressed by declining habitat, increased development, and other factors, could experience additional pressures as a result of climate change.

More frequent flooding events, erosion, wildfires and hotter temperatures all pose increased threats to cultural and paleontological sites and artifacts. Heat from wildfires, suppression activities and equipment, as well as greater ambient daytime heat can damage sensitive cultural resources. Similarly, flooding and erosion can wash away artifacts and damage cultural and paleontological sites. However, these same events may also uncover and lead to discoveries of new cultural and paleontological localities.

Climate change also poses challenges for many resource uses on BLM-administered land. Increased temperatures, drought, and evaporation may reduce seasonal water supplies for livestock and could impact forage availability. However, in non-drought years, longer growing seasons resulting from thermal increases may increase forage availability throughout the year. Shifts in wildlife habitat due to climate change may influence hunting and fishing activities, and early snowmelt may impact winter and water-based recreational activities. Drought and resulting stress on vegetation is likely to increase the frequency and intensity of mountain bark beetle and other insect infestations, which further increases the risk of fire and reduces the potential for sale of forest products on BLM-administered lands.

A variety of activities in the planning area currently generate GHGs. Fuels combustion, industrial processes, and any number of other activities on public lands result in direct emissions of GHGs. Direct emissions in the planning area include those related to current and ongoing oil and gas and other minerals development, fire events, motorized vehicle use (e.g., off-highway vehicles), livestock grazing, facilities development, and other fugitive emissions. Indirect GHG emissions in the planning area include the demand for electricity generated outside the area. Contributions to climate change also result from land use changes (conversion of land to less reflective surfaces that absorb heat, such as concrete or pavement), and soil erosion (which can reduce snow’s solar reflectivity and contribute to faster snowmelt).

Climate change science and projections of climate change is a continually growing and emerging science. Additional and recent information on climate change and regional projections of climate change for the

planning area can be found through the U.S. Global Change Research Program (http://www.globalchange.gov/) and the Intergovernmental Panel on Climate Change (http://www.ipcc.ch/).

Several federal initiatives have been launched to improve the ability to understand, predict, and adapt to the challenges of climate change. The Secretary of the Interior signed Secretarial Order 3289 on February 22, 2010, establishing a department-wide, scientific-based approach to increase understanding of climate change and to coordinate an effective response to impacts on managed resources. The order reiterated the importance of analyzing potential climate change impacts when undertaking long-range planning issues, and also established several initiatives, including the development of eight Regional Climate Science Centers. Regional Climate Science Centers would provide scientific information and tools that land and resource managers can apply to monitor and adapt to climate changes at regional and local scales (DOI, 2010). The North Central Climate Science Center, which incorporates the planning area, was established in 2011.

Given the broad spatial influence of climate change, which requires response at the landscape-level, the U.S. Department of the Interior (DOI) also established Landscape Conservation Cooperatives, which are management-science partnerships that help to inform management actions addressing climate change across landscapes. These Cooperatives are formed and directed by land, water, wildlife and cultural resource managers and interested public and private organizations, designed to increase the scope of climate change response beyond federal lands.

Other federal initiatives are being implemented to mitigate climate change. The Carbon Storage Project was implemented to develop carbon sequestration methodologies for geological (i.e., underground) and biological (e.g., forests and rangelands) carbon storage. The project is a collaboration of federal agency and external stakeholders to enhance carbon storage in geologic formations and in plants and soils in an environmentally responsible manner. The Carbon Footprint Project is a project to develop a unified GHG emission reduction program for the DOI, including setting a baseline and reduction goal for the Department’s GHG emissions and energy use. More information about DOI’s efforts to respond to climate change is available at: www.doi.gov/archive/climatechange/.

In addition to DOI’s efforts to address this issue, the EPA has undertaken a number of regulatory initiatives in recent years to reduce GHG emissions. This started in 2009 with a finding under the CAA identifying the key constituent gases that threaten public health and welfare and contribute to climate change. An initiative was developed for mobile sources by setting engine and fuel standards to cut GHGs

and fuel use for new motor vehicles, and the implementation of a renewable fuel standard aimed at decreasing oil imports and reducing GHGs. Another initiative addresses stationary sources to limit GHGs for power plants and other large industrial facilities.

The EPA also initiated a national GHG emissions reporting program for large emitters. Most recently (2012), EPA finalized regulations to reduce pollution from the oil and natural gas industry, which is expected to result in substantial reductions in VOC emissions, air toxics, and CH_4, an important GHG. These actions, initiatives, and regulations will impact activities in the planning area, especially those related to oil and natural gas development, in an overall effort to balance growth in resource development with continued reductions in key GHG emissions.

GHGs included in the U.S. GHG inventory are CO_2, CH_4, N_2O, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). CO_2 and CH_4 are typically emitted from combustion activities or are directly emitted into the atmosphere. Currently, the WDEQ, Air Quality Division does not regulate GHG emissions, although they are controlled indirectly by various other regulations.

Some GHGs, specifically CO_2, occur naturally and are released to the atmosphere through natural processes and human activities. Other GHGs (e.g., fluorinated gases) are created and released solely through human activities. The primary GHGs that enter the atmosphere because of anthropogenic activities include CO_2, CH_4, N_2O, and fluorinated gases such as HFCs, PFCs, and SF_6. These synthetic gases are released from a variety of industrial processes.

Several activities occur within the High Plains DO that may generate GHG emissions, including oil, gas, and coal development; large fires; livestock grazing; and recreation using combustion engines that can generate CO_2 and CH_4. Oil and gas development activities can generate CO_2 and CH_4. CO_2 emissions result from the use of combustion engines, while CH_4 can be released during processing. Wildland fires are also a source of other GHG emissions, while livestock grazing is a source of CH_4.

3.1.2 Air Quality and Visibility

The EPA established National Ambient Air Quality Standards (NAAQS) for criteria pollutants, including carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), particulate matter (PM_{10} and $PM_{2.5}$), sulfur dioxide (SO_2), and lead (Pb). The WDEQ is the agency that administers air quality for the State. Wyoming Ambient Air Quality Standards (WAAQS) and NAAQS identify maximum limits for concentrations of criteria air pollutants at all locations accessible by the public. The WAAQS and NAAQS are legally enforceable standards. Concentrations above the WAAQS and NAAQS represent a

risk to human health. By law, public safeguards must be implemented. State standards must be at least as protective of human health as federal standards and may be more restrictive than federal standards, as allowed by the Clean Air Act (CAA) of 1977, as amended.

If the concentration of one or more criteria pollutants in a geographic area is found to exceed the maximum limits for one or more of the NAAQS, the area may be classified as a nonattainment area. Areas with concentrations of criteria pollutants that are below the levels established by the NAAQS are considered either attainment or unclassifiable areas.

The counties that lie within the jurisdictional boundaries of the BLM High Plains District Office (DO) (Sheridan, Johnson, Campbell, Crook, Weston, Natrona, Converse, Niobrara, Platte, and Goshen) are classified as in attainment for all WAAQS and NAAQS. The one exception is the City of Sheridan, which is located more than 175 miles northwest of the Project Area and was designated as nonattainment for PM_{10} in 1991 (56 FR 11101). All sites operated by the WDEQ, Air Quality Division, in the High Plains DO, including the City of Sheridan, are currently in compliance with NAAQS and WAAQS.

Various State and federal agencies monitor air pollutant concentrations and visibility throughout Wyoming. Table 3-1 lists the available air quality monitoring sites within the High Plains DO and relevant sites nearby. The WDEQ operates PM_{10} monitors as part of the State and Local Air Monitoring Stations (SLAMS) network. Other sites include Interagency Monitoring of Protected Visual Environments (IMPROVE) network monitors and BLM-administered sites that are part of the Wyoming Air Resource Monitoring System (WARMS). Atmospheric deposition (wet) measurements of ammonium, sulfate, and various metals are taken at the Sinks Canyon and South Pass sites (operated by the BLM) and Yellowstone Park site (operated by the National Park Service) operated as part of the National Atmospheric Deposition Program (NADP).

Recent air quality conditions within the High Plains DO boundary were assessed by examining data collected by monitors in the area, as summarized in Table 3-2. The examination of the data indicates that the current air quality for criteria pollutants in the High Plains DO is good and in compliance with applicable NAAQS and WAAQS.

Table 3-1: Air Quality-Monitoring Sites within the High Plains District Office[1]

County	Site Name[1]	Type of Monitor[2]	Parameter[3]	Operating Schedule	Location	
					Longitude	Latitude
Campbell	Thunder Basin	SPM	O_3, NO_x & Met	Hourly	-105.2903	44.6522
	Campbell County	SPM	O_3, NO_x, PM_{10} & Met	Hourly	-105.5300	44.1470
	Belle Ayr Mine	SPM	NOx, & PM_{10}	Hourly (NO_x) & daily (PM_{10})	-105.3432	44.0971
	Wright	SPM	PM_{10}	Daily	-105.4914	43.7578
	Gillette	SLAMS	PM_{10}	Daily	-105.5170	44.2880
	Thunder Basin	IMPROVE	$PM_{2.5}$, nitrate ammonium, nitric acid, sulfate, SO_2 & Met	Every 3 days	-105.2874	44.6634
Johnson	Buffalo	WARMS	SO_2 & Met	Weekly	-106.10889	44.1442
	Cloud Peak	IMPROVE	$PM_{2.5}$, nitrate ammonium, nitric acid, sulfate, SO_2 & Met	Every 3 days	-106.9572	44.3334
Sheridan	Sheridan – Meadowlake	SLAMS	PM_{10} & $PM_{2.5}$	Daily	-106.9586	44.7955
	Sheridan – Police Station	SLAMS	PM_{10} & $PM_{2.5}$	Daily	-106.9559	44.8151
	Sheridan	WARMS	O_3, SO_2 & Met	Hourly (O_3) & weekly (SO_2)	-106.8472	44.9336
Converse	Converse County	SPM	NO_x, O_3, PM_{10}, & $PM_{2.5}$	Hourly	-105.3035	42.7670
Natrona	Casper Gaseous	SPM	NO_x & O_3	Hourly	-106.3650	42.8223
	Casper	SLAMS	PM_{10}, & $PM_{2.5}$	Daily	-106.3251	42.8511
Weston	Newcastle	WARMS	O_3, SO_2 & Met	Hourly (O_3) & weekly (SO_2)	-104.1919	43.8731

[1] Air quality monitors were identified via the interactive map on the EPA AirData website (http://www.epa.gov/airdata/ad_maps.html). Only non-industrial monitors are reported. Meteorological monitors listed were confirmed via the Wyoming Department of Environmental Quality, Wyoming Air Quality Monitoring Network webpage (http://www.wyvisnet.com/all.aspx) or the Bureau of Land Management Wyoming Air Resource Monitoring System page (http://www.blmwarms.net/monitoring-sites/newcastle-station.html).
[2] IMPROVE = Interagency Monitoring of Protected Visual Environments; SLAMS = State and Local Air Monitoring Stations; SPM = Special Purpose Monitoring; WARMS = Wyoming Air Resource Monitoring System
[3] Met = meteorology; NO_x = nitrogen oxides; O_3 = ozone; PM = particulate matter; SO_2 = sulfur dioxide

Table 3-2: Air Quality Conditions

Pollutant[1]	Averaging Time	NAAQS (WAAQS if different)[2,3]	Representative Concentrations[2,4]	Value Notes	Year/ Monitoring Station
CO	1 hour	35 ppm	1.8 ppm	No monitors in High Plains DO, the values reported are the highest second high in a given year for any monitor in Wyoming.	2009/ Yellowstone NP
	8 hour	9 ppm	1.0 ppm		2012/ Tata Gaseous
NO_2	1 hour	100 ppb	35.1 ppb	Maximum yearly 98th percentile for any given year.	2013/ Belle Ayr Mine (BA-4)
	Annual	53 ppb	7.6 ppb	Maximum annual arithmetic mean value for any given year	2012/ Belle Ayr Mine (BA-4)
Ozone	8 hour	0.075 ppm	0.071 ppm	Fourth highest daily maximum 8-hour ozone concentration in any given year	2012/ Thunder Basin
PM_{10}	24 hour	150 µg/m^3	104 µg/m^3	Highest daily 24-hour PM_{10} concentration in any given year	2012/ Gillette College Tech Center Mobile Trailer[6]
	Annual[5]	50 µg/m^3	22.1 µg/m^3	Maximum annual arithmetic mean value	2012/ Belle Ayr Mine (BA-4)
$PM_{2.5}$	24 hour	35 µg/m^3	27.1 µg/m^3	Highest yearly 98th percentile of the 24-hour $PM_{2.5}$ concentration	2010/ Sheridan – Police Station
	Annual	15 µg/m^3	8.8 µg/m^3	Highest yearly arithmetic mean value	2010/ Sheridan – Police Station
SO_2	1 hour	75 ppb	18 ppb	Weekly monitors reported have a maximum capture rate of 84 percent. Maximum yearly 99th percentile (for 1-hour) and highest second high (for 3-hour) value from hourly monitors in Wyoming.	2010/ Wyoming Refining
	3 hour (secondary)	0.5 ppm	0.0046 ppm		2010/ Wyodak Site 4

Source: EPA: http://www.epa.gov/air/criteria.html; WDEQ: http://soswy.state.wy.us/Rules/RULES/8887.pdf
[1] CO = carbon monoxide; NO_2 = nitrogen dioxide; PM = particulate matter; ppb = parts per billion; ppm = part per million; SO_2 = sulfur dioxide; µg/m^3 = micrograms per cubic meter
[2] NAAQS = National Ambient Air Quality Standards; WAAQS = Wyoming Ambient Air Quality Standards
[3] ppb = parts per billion; ppm = part per million; µg/m^3 = micrograms per cubic meter
[4] Annual summary air monitoring data for the 10 counties within the High Plains DO jurisdictional boundary was downloaded via the EPA AirData website (http://aqsdr1.epa.gov/aqsweb/aqstmp/airdata/download_files.html#Annual) for the most recent full 5 years (2009 through 2013). Only non-industrial monitors with 90 percent or greater collection rates were analyzed; the

maximum values for these monitors are reported in the table. For the pollutants that did not have monitors located within the High Plains DO boundary, annual summary data for monitors within the Wyoming State boundary were downloaded. For these statewide monitors, the maximum values for monitors with 90 percent or greater collection rates were analyzed and are reported in the table.

[5]NAAQS annual PM_{10} standard has been vacated. WAAQS limit.

[6]Gillette College Tech Center Mobile Trailer was only operational for 2011 and 2012

There are several national parks, national forests, recreation areas, and wilderness areas within and surrounding the High Plains DO. Certain national parks, national monuments, and wilderness areas are given special protection under the CAA. These protected areas are identified as federal "Class I" areas for the purposes of the visibility protection program. The CAA "declares as a national goal the prevention of any future, and the remedying of any existing, impairment of visibility in mandatory Class I federal areas… from manmade air pollution" (42 USC § 7491(a)(1).25). Under BLM Manual Section 8560.36, BLM lands, including wilderness areas not designated as Class I, are managed as Class II, which provides that moderate deterioration of air quality associated with industrial and population growth may occur. Table 3-3 lists areas designated as Class I or Class II.

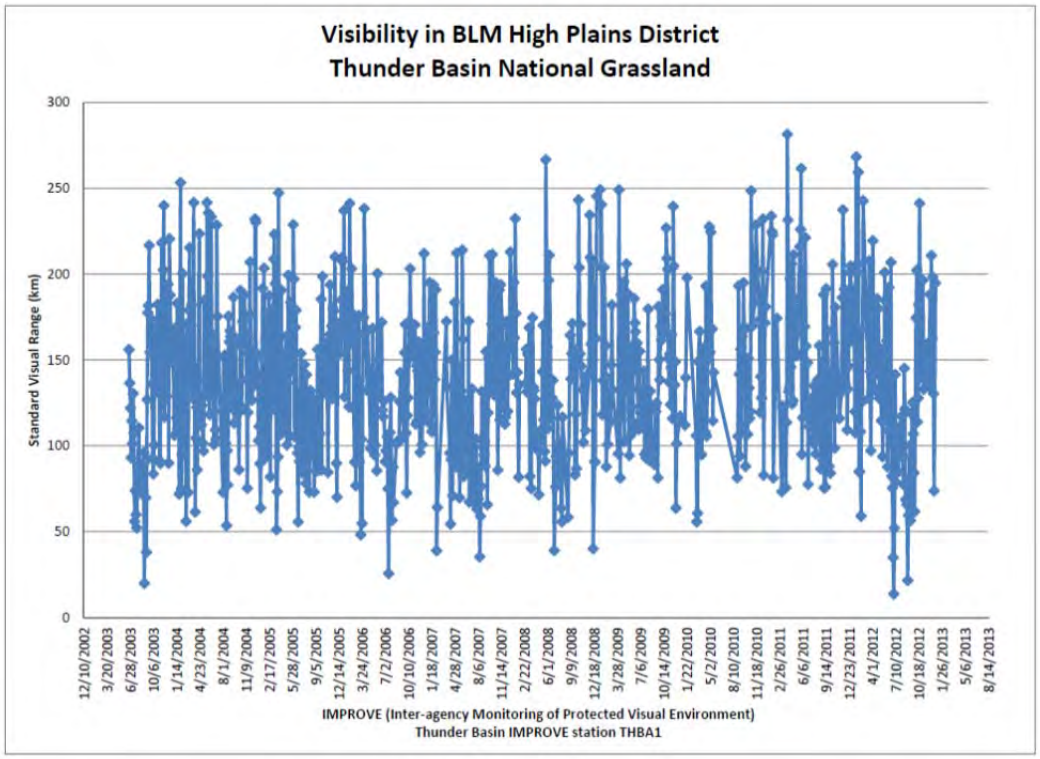
Table 3-3: National Parks, Wilderness Areas, and National Monuments

Area Name	Distance from High Plains District (miles)	Direction from the High Plains District	Clean Air Act Status of the Area
Badlands National Park	>100	East	Class I
Bridger Wilderness Area	90	West	Class I
Cloud Peak Wilderness Area	Within	---	Class II
Devils Tower National Monument	Within	---	Class II
Fitzpatrick Wilderness Area	100	West	Class I
Grand Teton National Park	>100	West	Class I
Jewel Cave National Monument	<20	East	Class II
North Absaroka Wilderness Area	>100	Northwest	Class I
Teton Wilderness Area	>100	Northwest	Class I
Washakie Wilderness Area	>100	Northwest	Class I
Wind Cave National Park	<50	East	Class I
Yellowstone National Park	>100	Northwest	Class I

The BLM works cooperatively with several other federal agencies to measure visibility with the IMPROVE network. Data collected at the Thunder Basin National Grasslands and Cloud Peak Wilderness IMPROVE monitoring sites have been used indirectly to measure visibility in the High Plains DO. Figure 3-3 presents visibility data for the Thunder Basin IMPROVE site for the period preceding 2014, and Figure 3-4 presents visibility data for the Cloud Peak IMPROVE site for the period preceding 2014. Data for the two sites are consistent and show very good to excellent visibility ranges, even for the haziest days (20 percent). In addition to visibility measurements within the High Plains DO, Figure 3-5 displays visibility estimates for the Wind Cave site, located east of the High Plains DO, preceding 2013.

Visibility can be characterized by a set of metrics. A light extinction coefficient is a way to describe changes in visibility due to changes in concentrations of air pollutants. A Koschmieder Coefficient is a way to describe how the human eye sees contrasts. Visual range can be calculated as the Koschmieder Coefficient divided by the light extinction coefficient. Data for the total light extinction coefficient was downloaded from the IMPROVE network site. To calculate the standard visual range (in kilometers), all records with missing data were removed and then the assumed Koschmieder Coefficient was divided by the total light extinction coefficient[3].

Figure 3-3: Standard Visual Range (SVR) for the Thunder Basin IMPROVE Site through 2013



[3] Equations found on the Visibility/Haze Metric Page on the Interagency Monitoring of Protected Environments website. http://vista.cira.colostate.edu/improve/tools/Vis_Haze_Metrics.htm. For a conservative analysis, the Koschmieder Coefficient was assumed to be 3.45 (half-way between the 3 to 3.9 range listed on the page).

Figure 3-4: Standard Visual Range (SVR) for the Cloud Peak IMPROVE Site through 2013

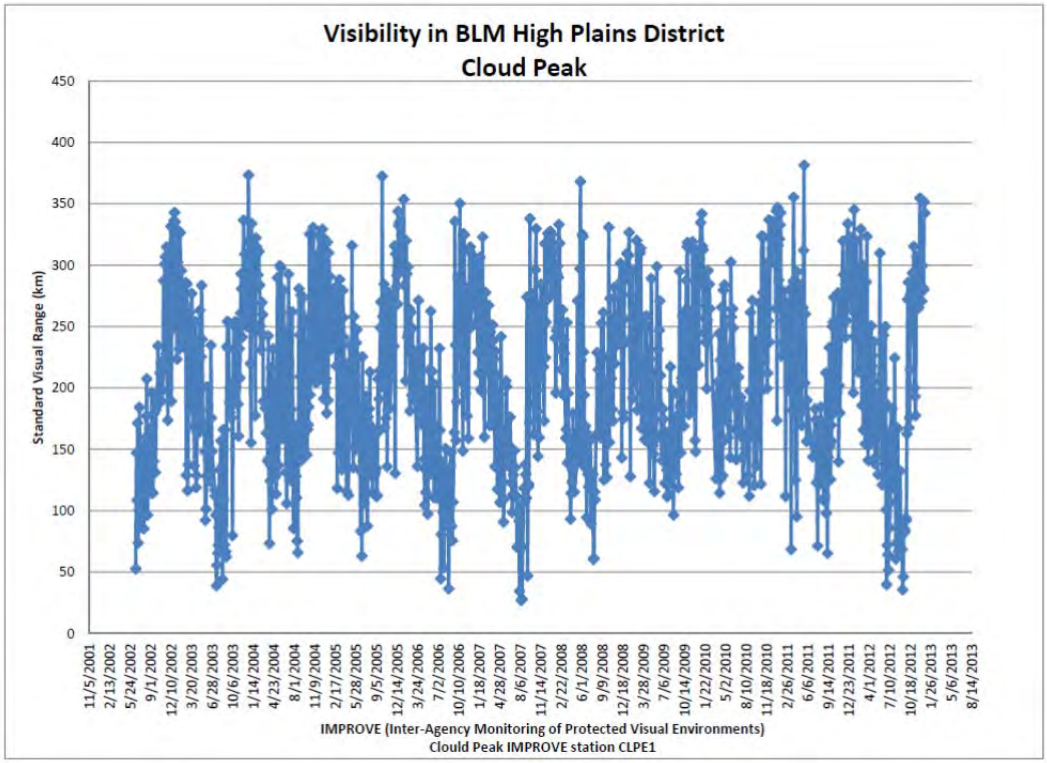
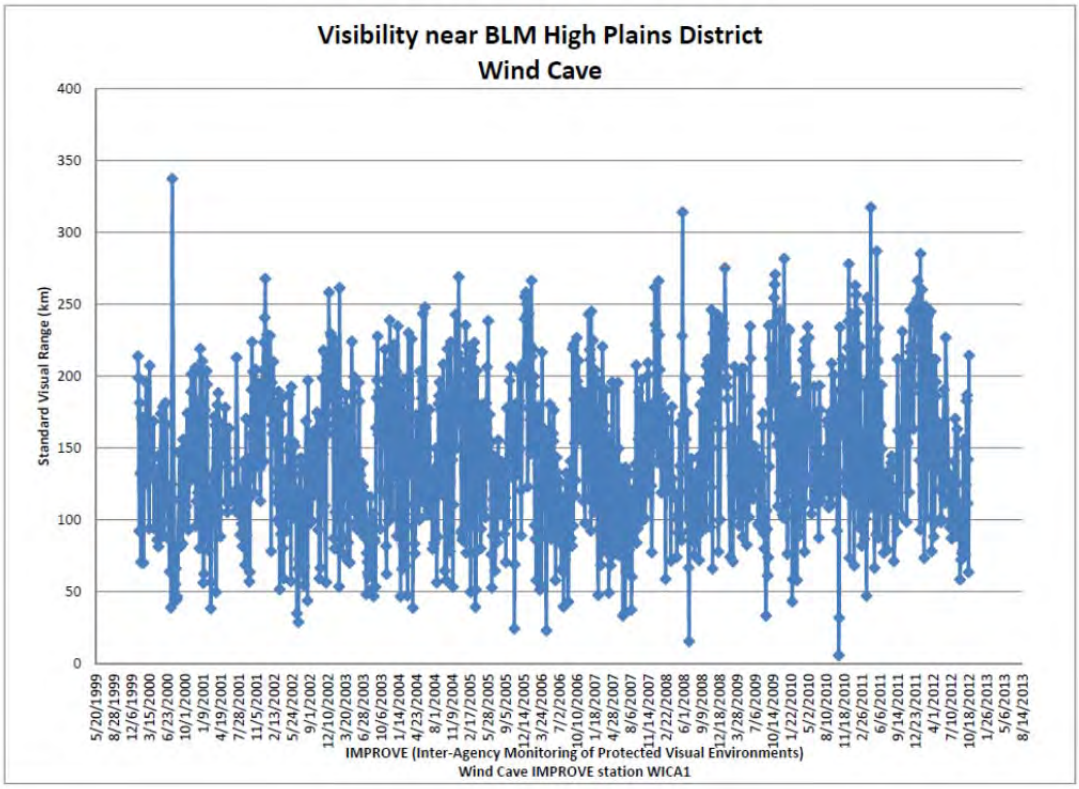


Figure 3-5: Standard Visual Range (SVR) for the Cave Wind IMPROVE Site through 2012



3.2 Heritage and Visual Resources

This section describes the cultural resources, paleontological resources, and visual resources within the Project Area.

3.2.1 Cultural Resources

Evidence of over 10,000 years of human habitation exists within the general area. This evidence has been documented through several decades of cultural resource work conducted for other energy actions in the area and information gathered through local informants and others interested in the cultural history of the area. The evidence includes habitation areas, lithic procurement and utilization areas, various hunting and gathering activities, and evidence of traditional cultural and spiritual practices. Several culturally and spiritually sensitive sites have been recorded in the general area but not in the specific proposed action areas.

3.2.2 Paleontology

The surface geology of the Project Area has been classified and scored by the Potential Fossil Yield Classification (PFYC) system, which indicates the relative potential for fossil materials to be present in given locations (BLM, 2007c). The PFYC is a relative value that rates the potential for an entire geologic formation and is not a true indicator of the presence or absence of fossils in any given location. For example, Morrison Shale has high concentrations of paleontological materials in some areas and is devoid of them in other areas. The PFYC assigns a numeric score between one and five, with five being the most sensitive. Paleontology localities are common in formations with a PFYC rating of five.

A large portion of the Project Area contains bedrock formations with a PFYC rating of 3/3a, indicating a moderate potential for the presence of fossil materials. The underlying formations along the southern and eastern edges of the Project Area have a PFYC rating of 5, which indicates a very high potential for the presence of fossil materials in these locations.

3.2.3 Visual Resources

The Visual Resource Management (VRM) system is the basic tool used by BLM to inventory and manage visual resources on public lands. All lands within the CFO have been classified into one of four classes (Class I, II, III, and IV), with management objectives defined for each class according to the BLM Visual Resource Handbook 8410-1. The entire Mohawk EA Project Area is within a Class IV VRM area. The objective in a Class IV area is to provide for development and activities that may require major modifications to the existing character of the landscape. The level of change to the characteristic landscape can be high. In a Class IV management area landscape, modifications may dominate the view

and be the major focus of the viewer attention. However, in a Class IV management area landscape, every attempt would be made to minimize the impacts of these activities through careful siting, minimal disturbance, and repetition of basic elements.

3.3 Range Management

There are six grazing allotments, defined as areas of land designated and managed for livestock grazing, that intersect the Project Area (Table 3-4). Table 3-4 includes the total allotment acreage, acreage of BLM land, BLM animal unit months (AUMs)[4], and the total acreage of the allotment that intersects the Project Area. Only two of the allotments contain BLM land.

Table 3-4: Grazing Allotments in the Project Area

Allotment Number	Allotment Name	Allotment Acreage	Acreage of BLM Lands within Allotment	AUMs on BLM Lands	Total Acres in Project Area
00231	Flat Top	3,730	80	8	3,658
00245	Shawnee Creek	2,133	N/A	N/A	1,853
00488	Park	4,005	160	35	2,594
10038	Stark	4,936	N/A	N/A	1,995
20513	Horner	2,611	N/A	N/A	41
20533	Middle Fork Shawnee Creek	10,689	N/A	N/A	1,030
	Total	28,104	240	43	11,171

Source: Gray, 2014

Existing range improvements within the overall Project Area generally include buried water pipelines, fences (pasture and/or boundary fences), reservoirs, stock tanks, and water wells. There are 35 permitted water wells that have been drilled and completed on lands throughout the Project Area and are designated for stock use (see Water Resources). Of these, 11 are designated solely for stock use and have depths ranging from 8 to 200 feet, with an average depth of 101 feet (WSEO, 2013).

3.4 Soils and Ecological Sites

Twenty-four unique soil mapping units were identified in the Project Area. Table 3-5 lists the dominant soil mapping units comprising at least two percent of the Project Area.

[4] An AUM is the amount of forage needed to sustain one cow and her calf, one horse, or five sheep or goats for a month.

Ecological Sites are soil and vegetation community descriptions compiled by the NRCS for the purpose of resource identification, and for providing management and reclamation recommendations. Ecological Sites associated with major soil units found in the Project Area are shown in Table 3-5, and include the Ponderosa Pine and Little Bluestem Forestland Ecological Site and the Loamy, Shallow Loamy, Shallow Sandy, and Shallow Clayey 10 to 14-inch Northern Plains Precipitation Zone rangeland Ecological Sites.

Table 3-5: Dominant Soils and Ecological Sites within the Project Area

Map Unit Symbol	Map Unit Name	Major Components	Ecological Sites	Acres	Percent of Project Area
229	Shingle, thin solum-Badland-Taluce, thin solum complex, wooded, 6 to 45 percent slopes	Shingle, thin solum (35 percent)	Ponderosa Pine and Little Bluestem (Forestland Ecological Site)	7,854	41 percent
		Badland (25 percent)			
		Taluce, thin solum (20 percent)			
251	Theedle-Kishona-Shingle loams, 3 to 30 percent slopes	Theedle (40 percent)	Loamy 10 to 14-inch Northern Plains Precipitation Zone	2,237	12 percent
		Kishona (20 percent)			
		Shingle (20 percent)	Shallow Loamy 10 to 14-inch Northern Plains Precipitation Zone		
189	Kishona-Cambria-Theedle loams, 3 to 20 percent slopes	Kishona (40 percent)	Loamy 10 to 14-inch Northern Plains Precipitation Zone	1,939	10 percent
		Cambria (25 percent)			
		Theedle (25 percent)			
154	Forkwood-Cambria-Cushman loams, 6 to 15 percent slopes	Forkwood (35 percent)	Loamy 10 to 14-inch Northern Plains Precipitation Zone	1,355	7 percent
		Cambria (30 percent)			
		Cushman (20 percent)			
233	Shingle-Taluce-Badland complex, 10 to 40 percent slopes	Shingle (30 percent)	Shallow Loamy 10 to 14-inch Northern Plains Precipitation Zone	1,241	7 percent

Map Unit Symbol	Map Unit Name	Major Components	Ecological Sites	Acres	Percent of Project Area
		Taluce (25 percent)	Shallow Sandy 10 to 14-inch Northern Plains Precipitation Zone		
		Badland (20 percent)	N/A		
230	Shingle-Badland-Samday complex, 10 to 30 percent slopes	Shingle (40 percent)	Shallow Loamy 10 to 14-inch Northern Plains Precipitation Zone	1,009	5 percent
		Badland (25 percent)	N/A		
		Samday (20 percent)	Shallow Clayey 10 to 14-inch Northern Plains Precipitation Zone		
250	Theedle-Kishona loams, 6 to 15 percent slopes	Theedle (45 percent)	Loamy 10 to 14-inch Northern Plains Precipitation Zone	762	4 percent
		Kishona (35 percent)			
187	Kishona-Cambria loams, 0 to 6 percent slopes	Kishona (45 percent)	Loamy 10 to 14-inch Northern Plains Precipitation Zone	492	3 percent
		Cambria (40 percent)			
152	Forkwood-Cambria loams, 0 to 6 percent slopes	Forkwood (45 percent)	Loamy 10 to 14-inch Northern Plains Precipitation Zone	429	2 percent
		Cambria (35 percent)			

Source: NRCS, 2014a

The Ponderosa Pine and Little Bluestem Ecological Sites that extend through the Project Area are associated with the Shingle, thin solum-Badland-Taluce, thin solum complex, the most dominant soil complex in the Project Area (covering approximately 41 percent of land surface). The Shingle, thin solum component, which makes up 35 percent of the complex, is found on uplands and hills and consists of colluvium and/or residuum weathered from sandstone and shale (NRCS, 2014a). The soils are shallow (4 to 10 inches to bedrock) and well-drained, with loam and clay loam textures and moderately high permeability. The Taluce, thin solum component, comprising 20 percent of the complex, is also found on uplands and hills and consists of residuum weathered from calcareous sandstone. These soils are fine

sandy loam in texture, well-drained, shallow (less than 20 inches to bedrock), and highly permeable. The third major component of the soil complex consists of badlands, or barren areas of exposed bedrock.

Loamy Ecological Sites are associated with six of the nine major soil map units found within the Project Area and are characterized by deep to moderately deep (greater than 20 inches to bedrock), well-drained, and moderately permeable soils (NRCS, 2014a and 2014b). Project Area soil components correlated with the Loamy Ecological Site include Theedle, Kishona, Cambria, Forkwood, and Cushman, which primarily consist of alluvium and/or residuum weathered or derived from sandstone and shale. These soils are loam and clay loam in texture and are found on gently undulating rolling lands.

Shallow Loamy Ecological Sites, which are associated with three of the nine major soil map units in the Project Area, are characterized by shallow, well-drained, moderately permeable soils (NRCS, 2014a and 2014b). Within the Project Area, the Shallow Loamy Ecological Site is correlated with the Shingle soil component. These loam and clay loam soils are found on slopes and consist of residuum weathered from sandstone and shale.

A small portion of the Project Area is characterized as a Shallow Sandy Ecological Site, which is associated with the Taluce component of the Shingle-Taluce-Badland complex. The Shallow Sandy Ecological Site typically consists of shallow, well-drained soils with moderately rapid to rapid permeability (NRCS, 2014a and 2014b). These fine sandy loam soils occur on slopes and consist of alluvium and/or residuum weathered or derived from sandstone.

The Shallow Clayey Ecological Site, which is associated with the Samday component of the Shingle-Badland-Samday complex, also comprises a small portion of the Project Area. Typical soils of the Shallow Clayey Ecological Site are shallow, well-drained, and have moderate to slow permeability (NRCS, 2014a and 2014b). These clay loam and clay textured soils occur on slopes and consist of residuum weathered from calcareous shale.

Soil stability is greatly affected by slope. In general, the potential for slumping, landslides, and water erosion rises with increasing slope. Approximately 43 percent (8,096 acres) of the Project Area has slopes greater than 25 percent. These steep slopes primarily occur within the ponderosa pine woodland areas in the western and central portions of the Project Area.

Soils are susceptible to erosion in varying degrees. For example, a sandy Ecological Site has 52 to 80 percent sand in the top few inches and 10 to 18 percent clays. A sandy Ecological Site located on a ridge top with topsoil depths averaging 2 to 4 inches could be susceptible to wind and water erosion due to

relatively small amounts of clay and little water holding capacity. Approximately 125 acres within the Project Area, or less than 1 percent, are classified as having high potential for water erosion. No soils classified as having high potential for wind erosion are located in the Project Area.

3.5 Vegetation

This section describes the plant communities and noxious weed species present within the Project Area.

3.5.1 Plant Communities

The Project Area is generally comprised of sagebrush (*Artemisia* spp.) grassland and ponderosa pine (*Pinus ponderosa*) forest (BHEC, 2014a, 2014b, and 2014c). Cottonwood trees (*Populus* spp.) are common along the east and middle forks of Shawnee Creek and are scattered in drainages throughout the Project Area. Juniper trees (*Juniperus* spp.) are also present in several drainages. Big sagebrush (*Artemisia* spp.), prickly pear (*Opuntia polyacantha*), western wheat grass (*Agropyron smithii*), needle and thread (*Hesperostipa comata*), prairie Junegrass (*Koeleria macrantha*), blue gramma (*Bouteloua gracilis*), and cheatgrass (*Bromus* spp.) are common.

Table 3-6 lists the major vegetation cover types and percent of the overall Project Area based on Wyoming Gap Analysis Program (GAP) data. The Wyoming GAP data set includes land cover and primary vegetation types for the entire State of Wyoming

Table 3-6: Vegetation Cover Types in the Project Area

Vegetation Cover Type	Acres	Percent of Project Area
Basin exposed rock/soil	1,945	10 percent
Mixed-grass prairie	7,267	38 percent
Ponderosa pine intact	8,030	42 percent
Wyoming big sagebrush	1,807	9 percent

Source: Gray, 2014

3.5.2 Invasive, Non-Native Plant Species

Non-native plant species that are difficult to control, easily spread, and injurious to public health, crops, livestock, land or other property have been designated as noxious weeds under the Wyoming Weed and Pest Control Act of 1973 (Wyoming Statute [W.S.] 11-5-102[a][xi] and W.S. 11-12-104). The Wyoming Weed and Pest Council, which is comprised of 23 Weed and Pest Districts divided along county boundaries, maintains a list of State designated and prohibited noxious weeds (Table 3-7). County Weed and Pest Control Districts may declare additional noxious weeds in their localities (W.S. 11-5-102[a][vii] through 11-5-102[a][viii] and W.S. 11-5-105[a][vi]) (REF 9051).

Table 3-7: Designated Noxious Weeds in Wyoming

Common Name	Scientific Name
Canada thistle	*Cirsium arvense*
Common burdock	*Arctium minus*
Common St. Johnswort	*Hypericum perforatum*
Common tansy	*Tanacetum vulgare*
Dalmatian toadflax	*Linaria dalmatica*
Diffuse knapweed	*Centaurea diffusa* Lam.
Dyer's woad	*Isatis tinctoria*
Field bindweed	*Convolvulus arvensis*
Hoary cress (whitetop)	*Cardaria draba and Cardaria pubescens*
Houndstongue	*Cynoglossum officinale*
Leafy spurge	*Euphorbia esula*
Musk thistle	*Carduus nutans*
Oxeye daisy	*Chrysanthemum leucanthemum*
Perennial pepperweed (giant whitetop)	*Lepidium latifolium*
Perennial sowthistle	*Sonchus arvensis*
Plumeless thistle	*Carduus acanthoides*
Purple loosestrife	*Lythrum salicaria*
Quackgrass	*Agropyron repens*
Russian knapweed	*Centaurea repens*
Russian olive	*Elaeagnus angustifolia*
Saltcedar	*Tamarxix* ssp.
Scotch thistle	*Onopordum acanthium*
Skeletonleaf bursage	*Franseria discolor*
Spotted knapweed	*Centaurea maculosa*
Yellow toadflax	*Linaria vulgaris*

Source: Wyoming Weed and Pest Council, 2014

3.6 Water Resources

This section describes the groundwater and surface water resources within the Project Area.

3.6.1 Groundwater

The Wyoming State Engineer's Office (WSEO) lists 35 permitted water wells within the Project Area, the majority of which (24) have designated uses associated with stock watering, but may also be used for domestic supply, industrial supply, and other miscellaneous uses (WSEO, 2013). The wells in the Project Area are identified in Table 3-8.

Table 3-8: Permitted Water Wells within the Project Area

Number of Well Permits	Permit Type	Well Depths (feet)	Average Well Depth (feet)
11	Stock watering	8-200	101
11	Stock watering; Domestic	100-600	241
1	Stock watering; Domestic; Industrial	465	465
1	Stock watering; Miscellaneous	2,119	2,119
4	Domestic	120-270	195
3	Miscellaneous	270-2,119	1,195
2	Domestic; Industrial; Miscellaneous	900	900
2	Monitoring	No data	No data

Source: WSEO, 2013

The major aquifers underlying the Project Area include the Fort Union Formation (Early Tertiary) and White River Formation (Late Tertiary) (WWDC, 2014a and 2014b). The Fort Union Formation ranges from 2,300 to 6,000 feet in thickness and is divided into three members, including the Tongue River, Lebo, and Tullock Members (Taucher, et al., 2013). This aquifer is widely used to supply water for stock and domestic purposes and is also used for public supply in some areas. The thickness of the White River Formation ranges from 0 to 700 feet depending on location and is divided into an upper part (Brule Formation) and a lower part (Chadron Formation) in many locations. The White River Formation is part of the regional High Plains aquifer system, which is the predominant groundwater resource for irrigation in southeastern Wyoming. The High Plains system is also used for municipal, industrial, stock, and domestic purposes.

3.6.2 Surface Water and Wetlands

The majority of the Project Area is located within the Glendo Reservoir Watershed (HUC 10180008), with the northeast corner of the Project Area located within the Lightning Creek Watershed (HUC 10120105). Named streams of the Glendo Reservoir Watershed within the Project Area include Dip Creek, East Fork of Shawnee Creek, Middle Fork of Shawnee Creek, West Fork of Shawnee Creek, and Whackoff Creek. Twentymile Creek, within the Lightning Creek Watershed, also extends through the Project Area. All streams within the Project Area are intermittent and normally flow only during periods of spring runoff and/or localized periods of heavy rainfall.

According to the electronic records of the WSEO (2013), there are 22 permitted reservoirs within the Project Area, including 21 reservoirs used exclusively for stock watering purposes and 1 reservoir used

for both flood control and stock watering. Reservoir capacity ranges from 0.8 acre-feet to 170.5 acre-feet, with an average capacity of 21.9 acre-feet.

Table 3-9 displays the types and total acreages of wetlands within the Project Area based on U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) data (USFWS, 2014). NWI wetlands within the Project Area primarily include ponds and emergent wetlands adjacent to the streams and drainages that dissect the Project Area.

Table 3-9: NWI Wetlands in the Project Area

Wetland Type	Acres
Freshwater Emergent Wetland	25.6
Freshwater Forested/Shrub Wetlands	0.4
Freshwater Pond	62.8
Other	6.7
Total:	95.5

Source: USFWS, 2014a

3.7 Wildlife, Special Status Species, and Threatened and Endangered Species

This section describes the wildlife and protected species within the Project Area, including big game species, raptors, federally listed threatened and endangered species, BLM sensitive species, and migratory birds. Wildlife surveys were conducted by Big Horn Environmental Consultants (BHEC) in association with the APD applications for the three site-specific well pads (BHEC, 2014a, 2014b, and 2014c). The areas surveyed included the well pads locations, proposed new or upgraded access roads, and appropriate species-specific buffers based on established USFWS, Wyoming Game and Fish Department (WGFD), and/or BLM CFO survey protocols. The surveys were conducted in April, May, and June 2014, with the exception of bald eagle surveys, which were conducted in December 2013 and January 2014. Table 3-10 lists the species that were included in the surveys and the results of the surveys. Wildlife surveys will be conducted for the conceptual well pads (#4, #5, and #6) at the time of APD submittal.

Table 3-10: Results of Wildlife Surveys Conducted for Well Pads #1, #2, and #3

Common Name	Scientific Name	Survey Results
Big Game Species		
Mule deer	*Odocoileus hemionus*	Species observed in surrounding areas
North American pronghorn	*Antelocapra americana*	Species observed in surrounding areas
Rocky Mountain elk	*Cervus elaphus*	Species or signs of species observed in surrounding areas

Common Name	Scientific Name	Survey Results
Threatened and Endangered Species		
Black-footed ferret	*Mustela nigripes*	Northeast Wyoming received a block clearance for black-footed ferrets in 2003 from the U.S. Fish and Wildlife Service. Species not likely to be present.
Preble's meadow jumping mouse	*Zapus hudsonius preblei*	No suitable habitat observed
Ute ladies'-tresses orchid	*Spiranthes diluvialis*	No suitable habitat observed
Blowout penstemon	*Penstemon haydenii*	No suitable habitat observed
Colorado butterfly plant	*Gaura neomexicana coloradensis*	No suitable habitat observed
Wildlife Species of Concern		
Bald eagle	*Haliaeetus leucocephalus*	No species or nests observed
Burrowing owl	*Athene cunicularia*	No species or nests observed
Other raptors	various species	One active golden eagle nest and one inactive raptor nest (unknown species) observed.
Greater sage-grouse	*Centrocercus urophasianus*	No species observed. North Shawnee lek (inactive since 2011) located within survey area.
Sharp-tailed grouse	*Tympanuchus phasianellus*	No species observed
Mountain plover	*Charadrius montanus*	No species or suitable breeding habitat observed
Loggerhead shrike	*Lanius ludovicianus*	Suitable habitat present
Baird's sparrow	*Ammodramus bairdii*	Suitable habitat present
Brewer's sparrow	*Spizella breweri*	Suitable habitat present
Sage sparrow	*Amphispiza billneata*	Suitable habitat present
Sage thrasher	*Oreoscoptes montanus*	Suitable habitat present
Black-tailed prairie dog	*Cynomys ludovicianus*	No colonies observed

Source: BHEC, 2014a, 2014b, and 2014c

Additional information regarding wildlife and protected species in the Project Area is discussed below.

3.7.1 Big Game Species

Several big game species, including elk, mule deer, pronghorn, and white-tailed deer, may occur in the general vicinity of the Project Area. No designated crucial range, parturition areas (i.e., lambing, fawning, and calving areas), or migration routes for these big game species overlap the Project Area; however, yearlong and/or winter/yearlong range for pronghorn, mule deer, and white-tailed deer are present throughout the Project Area (WGFD, 2013). The acreages of these various seasonal ranges within the

Project Area are included in Table 3-11. Range designated by WGFD as winter/yearlong is used by a population or portion of the population on a year-round basis, with significant influx of additional animals into the area from other seasonal ranges during the winter months (between December 1 and April 30). While no designated ranges for elk overlap the Project Area, this species may utilize the Project Area at variable times when suitable habitat and conditions exist.

Table 3-11: Big Game Species Seasonal Ranges within Project Area

Seasonal Range	Acres within Project Area	Percent of Project Area
Pronghorn year-long range	15,632	82%
Pronghorn winter/year-long range	3,417	18%
Mule deer year-long range	668	4%
Mule deer winter/year-long range	18,381	96%
White-tailed deer year-long range	2,119	11%

Source: WGFD, 2013

Pronghorn species residing in the Project Area are classified within the Cheyenne River pronghorn antelope herd unit (PR740), including pronghorn hunt area 29. The population of this herd was generally stable and near the population management goal, or "objective," between 1993 and 2002, and then the population increased between 2002 and 2007 due to good fawn survival rates and low sales of doe/fawn hunting licenses (WGFD, 2012). The herd population has dropped steadily since 2007, as a result of increased license sales and lower fawn survival rates, and was lower than objective in 2012. In 2013, WGFD reduced both doe/fawn and buck licenses and, therefore, anticipates the population to grow approximately 6 percent to a 2013 post-season objective of 33,100 pronghorn.

Mule deer species residing in the Project Area are classified within the Cheyenne River mule deer herd unit (MD740), including mule deer hunt area 14. The population of this herd peaked near objective in 2000 and then dropped dramatically following a tough winter (WGFD, 2012). The herd rebounded between 2002 and 2006, leveled off in 2007 at 15 percent below objective, and has declined every year since 2007. The herd was 54 percent below its objective of 38,000 individuals in 2012. This trend corresponds with recent studies showing that mule deer populations are experiencing a decline in overall numbers and herd size within Wyoming (Sawyer, et al., 2009). Mule deer avoidance of well pads and associated facilities was found to increase commensurate with the level of human activity in the area; unstaffed well pads were avoided relatively less. Similarly, mule deer were found to avoid roadways with high levels of traffic, and showed an increased presence along roads with low to no use.

The Project Area is overlapped by the Central white-tailed deer herd unit (WT707), which encompasses a large portion of east-central Wyoming. WGFD does not model population for this herd, and management is instead based on a goal of maintaining a postseason ratio of greater than or equal to 20 bucks per 100 does (WGFD, 2012). Management objectives for this herd have always been met, and in 2012, the observed ratio was 34 bucks per 100 does.

3.7.2 Raptors

Most raptor species nest in a variety of habitats including, but not limited to, native and non-native grasslands, agricultural lands, live and dead trees, cliff faces, rock outcrops, and tree cavities. Suitable nesting habitat is present throughout the Project Area. Based on the CFO raptor database and APC raptor inventory data, multiple raptor nest sites are located throughout the Project Area (Gray, 2014; Abeloe, 2013). Additionally, individual inventories have been conducted on a case-by-case basis in response to both past and present activities proposed by APC and other operators in the area, but these inventories were generally limited to historic nests located within a 0.5-mile radius of each proposed federal action. Table 3-12 identifies the known raptor nest sites within the Project Area.

Common raptor species which may occur within the Project Area include northern harrier (*Circus cyaneus*), golden eagle (*Aquila chrysaetos*), red-tailed hawk (*Buteo jamaicensis*), Swainson's hawk (*Buteo swainsoni*), ferruginous hawk (*Buteo regalis*), American kestrel (*Falco sparverius*), prairie falcon (*Falco mexicanus*), short-eared owl (*Asio flammeus*), and great horned owl (*Bubo virginianus*). Less common raptors in the Project Area include osprey (*Pandion haliaetus*), bald eagle (*Haliaeetus leucocephalus*), rough legged hawk (*Buteo lagopus*), merlin (*Falco columbarius*), and burrowing owl (*Athene cunicularia*). Several of these species (bald eagle, ferruginous hawk, and burrowing owl) have been recognized as BLM sensitive species and are discussed in the Section 3.7.4.

Raptor nest surveys were conducted in association with the APD applications for the three site-specific well pads to assess the activity and nest conditions of known and historic raptor nest locations within 0.5-mile of the proposed well pad construction areas (BHEC, 2014a, 2014b, and 2014c). Within the 0.5-mile survey areas for the three well pads, one active golden eagle nest (Nest ID 11253) was identified that produced one young in 2014 (BHEC, 2014a, 2014b, and 2014c). One inactive raptor nest (Nest ID BH1395) was also identified within the survey area. No bald eagles were observed during the winter roost surveys, and no bald eagle nests were located during the spring raptor nest surveys.

A comprehensive survey of raptor nests for the conceptual well pads would be conducted for each individual project when the APD is processed.

Table 3-12: Known Raptor Nest Sites within 0.5-Mile of Project Area

Nest ID	Location	Substrate	Condition	Species	Activity
11253	NESE, S12, T32N, R69W	Cottonwood tree (live)	Good	Golden eagle	1 young produced in 2014
11255	NWSW, S2, T32N, R69W	Cottonwood tree (live)	Nest gone	N/A	Gone
326903SESE	SESE, S3, T32N, R69W	Cottonwood tree (live)	Good	Unknown raptor	Inactive
5236	NWNE, S14, T32N, R69W	Cottonwood tree (dead)	Nest gone	N/A	Gone
5252	NENE, S32, T33N, R68W	Cottonwood tree (dead)	Nest gone	Red-tailed hawk	Gone
BH13100	NESE, S18, T33N, R68W	Ponderosa pine (live)	Good	Golden eagle	Inactive
BH13101	NWSE, S31, T33N, R68W	Ponderosa pine (dead)	Excellent	Golden eagle	Inactive
BH13102	SWSW, S2, T32N, R69W	Ponderosa pine (live)	Good	Unknown raptor	Inactive
BH1395	NENE, S34, T33N, R68W	Ponderosa pine	Fair	Unknown raptor	Inactive
BH1398	SWNW, S21, T33N, R68W	Ponderosa pine (dead)	Good	Unknown raptor	Inactive
BH1476	SENE, S6, T32N, R68W	Cottonwood tree (live)	Good	Red-tailed hawk	2 young produced in 2014

Source: Gray, 2014; Abeloe, 2013; BHEC, 2014a, 2014b, and 2014c

3.7.3 Threatened and Endangered Species

An endangered species is a species listed under the Endangered Species Act (ESA) of 1973, as amended, as being in danger of extinction throughout all or a portion of its range. A threatened species is a species listed under the ESA as likely to become endangered within the foreseeable future throughout all or a portion of its range.

In accordance with the ESA, the lead agency in coordination with the USFWS must require that any authorized, funded, or implemented federal action not adversely affect a federally listed threatened or endangered species or its critical habitat. Table 3-13 lists federally listed species identified as potentially occurring in Converse County.

Table 3-13: Federally Listed Species Identified as Potentially Occurring within the Project Area

Species Name	Designation	Habitat Type	Habitat Present in Project Area
Preble's meadow jumping mouse (*Zapus hudsonius preblei*)	Threatened	Foothills and plains riparian corridors with dense, herbaceous riparian vegetation	No
Ute ladies'-tresses (*Spiranthes diluvialis*)	Threatened	Moist meadows associated with perennial stream terraces, floodplains, and oxbows at elevations between 4,300 and 6,850 feet.	No
Platte River species critical habitat:		If the Proposed Action may lead to consumptive use of water or have the potential to affect water quality in the Platte River system, there may be impacts to threatened and endangered species inhabiting downstream reaches of this river system	
Interior least tern (*Sterna antillarum*)	Endangered		
Pallid sturgeon (*Scaphirhynchus albus*)	Endangered		
Piping plover (*Charadrius melodus*)	Threatened		
Western prairie fringed orchid (*Platanthera praeclara*)	Threatened		
Whooping crane (*Grus americana*)	Endangered		

Source: USFWS, 2014b

Preble's meadow jumping mouse – The Preble's meadow jumping mouse, currently listed as threatened, is typically found in heavily vegetated, shrub-dominated riparian habitats in southeastern Wyoming and Colorado. Perennial water sources and associated riparian habitats are not present within the Project Area, and, therefore, this species is not likely to be present (BHEC, 2014a, 2014b, and 2014c).

Ute ladies'-tresses – In Wyoming, suitable habitat for Ute ladies'-tresses orchid consists of low, flat floodplain terraces or abandoned oxbows in close proximity to small perennial streams or rivers, between elevations of 4,750 and 5,400 feet (Fertig, 2000; Heidel, 2007). The Project Area is located in dry upland vegetation with no source of perennial water. The ephemeral drainages have heavy clay soils and immediately rise to upland vegetation, reducing potential for this species to be present. No populations of Ute ladies'-tresses orchid are known within this area. Although the Casper RMP indicated that streams in the Project Area may be suitable habitat, the field surveys suggested that there is unsuitable habitat for this species. Also, the absence of an historic population to provide a seed source make it unlikely that the Project Area would support a future population of Ute ladies'-tresses orchids (BHEC, 2014a, 2014b, and 2014c).

Species affected by North Platte River water depletions – North Platte River species are those species that may occur in the downstream riverine habitats of the North Platte River in Nebraska, but could be adversely affected by water depletions in the North Platte River system that could result from Project-related activities. These species include the interior least tern, piping plover, pallid sturgeon, whooping crane, and western prairie fringed orchid. The majority of the Project Area (except for the northeast corner) is located within the Glendo Reservoir Watershed, a sub-basin of the North Platte Watershed.

3.7.4 BLM Sensitive Species

The BLM policy in *Manual 6840 - Special Status Species Management* requires the BLM to manage and protect any USFWS candidate species, State sensitive species, or State species of concern to prevent the need for future federal listing as threatened or endangered. Table 3-14 lists BLM sensitive species that occur within the CFO region and their habitat preferences. As indicated in the table, 20 of these sensitive species are likely to occur within the Project Area, based on a review of preferred habitat types.

Table 3-14: Wyoming BLM Special Status Sensitive Species and Habitat Preferences

Common Name	Scientific Name	Preferred Habitat	May Occur[1]
Mammals			
Townsend's big-eared bat	*Corynorhinus townsendii*	Forests, basin-prairie shrub, caves and mines	Yes
White-tailed prairie dog	*Cynomys leucurus*	Basin-prairie shrub, grasslands	Yes
Black-tailed prairie dog	*Cynomys ludovicianus*	Short-grass prairie	Yes
Spotted bat	*Euderma maculatum*	Cliffs over perennial water, basin-prairie shrub	No
Long-eared myotis	*Myotis evotis*	Conifer and deciduous forests, caves and mines	Yes
Fringed myotis	*Myotis thysanodes*	Conifer forests, woodland-chaparral, caves and mine	Yes
Swift fox	*Vulpes velox*	Grasslands	Yes
Preble's meadow jumping mouse	*Zapus hudsonius preblei*	Heavily vegetated, shrub-dominated riparian (streamside) zones	No
Birds			
Northern goshawk	*Accipiter gentilis*	Conifer and deciduous forests	Yes
Baird's sparrow	*Ammodramus bairdii*	Grasslands, weedy fields	Yes
Sage sparrow	*Amphispiza belli*	Basin-prairie shrub, mountain-foothill shrub	Yes
Burrowing owl	*Athene cunicularia*	Grasslands, basin-prairie shrub	Yes

Common Name	Scientific Name	Preferred Habitat	May Occur[1]
Ferruginous hawk	*Buteo regalis*	Basin-prairie shrub, grassland, rock outcrops	Yes
Greater sage-grouse	*Centrocercus urophasianus*	Basin-prairie shrub, mountain-foothill shrub	Yes
Mountain plover	*Charadrius montanus*	Short-grass and mixed-grass prairie, openings in shrub ecosystems, prairie dog towns	Yes
Yellow-billed cuckoo	*Coccyzus americanus*	Open woodlands, streamside willow and alder groves	Yes
Trumpeter swan	*Cygnus buccinator*	Lakes, ponds, rivers	No
Peregrine falcon	*Falco peregrinus*	Tall cliffs	No
Bald eagle	*Haliaeetus leucocephalus*	Primarily along rivers, streams, lakes and waterways	Yes
Loggerhead shrike	*Lanius ludovicianus*	Basin-prairie shrub, mountain-foothill shrub	Yes
Long-billed curlew	*Numenius americanus*	Grasslands, plains, foothills, wet meadows	Yes
Sage thrasher	*Oreoscoptes montanus*	Basin-prairie shrub, mountain-foothill shrub	Yes
White-faced ibis	*Plegadis chihi*	Marshes, wet meadows	No
Brewer's sparrow	*Spizella breweri*	Basin-prairie shrub	Yes
Amphibians			
Northern leopard frog	*Rana pipiens*	Beaver ponds, permanent water in plains and foothills	No
Plants			
Laramie columbine	*Aquilegia laramiensis*	Crevices of granite boulders and cliffs 6,400 to 8,000 feet	No
Porter's sagebrush	*Artemisia porteri*	Sparsely vegetated badlands of ashy or tufaceous mudstone and clay slopes 5,300 to 6,500 feet	No
Many-stemmed spider-flower	*Cleome multicaulis*	Semi-moist, open saline banks of shallow ponds & lakes with baltic rush & bulrush 5,900 feet	No
Williams' wafer-Parsnip	*Cymopterus williamsii*	Open ridgetops and upper slopes with exposed limestone outcrops or rockslides 6,000 to 8,300 feet	No

Common Name	Scientific Name	Preferred Habitat	May Occur[1]
Limber pine	*Pinus flexilis*	Timberline and at lower elevation with sagebrush. Associated species are Rocky Mountain lodgepole pine, Engelmann spruce, whitebark pine, Rocky Mountain douglas-fir, subalpine fir, Rocky Mountain juniper, mountain mahogany, and common juniper	Yes
Laramie false sagebrush	*Sphaeromeria simplex*	Cushion plant communities on rocky limestone ridges and gentle slopes 7,500 to 8,600 feet	No

Source: BLM, 2010
[1]Yes = May occur in or in the vicinity of the Project Area based on habitat preference; No = Not likely to occur in or in the vicinity of the Project Area based on habitat.

Townsend's big-eared bat – The Townsend's big-eared bat relies on cave-like structures for shelter during all stages of its life, including maternity roosts, day and night roosts, and hibernacula (Gruver and Keinath, 2003). The bats generally use caves and mines but have also been known to use hollows in large trees and abandoned buildings. They forage in forested habitat, along heavily vegetated stream corridors, and in open areas near wooded habitat. They are found throughout most of the western United States, including Wyoming. There are no documented occurrences of this species in the Project Area (WYNDD, 2014).

White-tailed prairie dog – White-tailed prairie dogs are typically found in shrub-steppe and grassland habitats at mid-elevations (Keinath, 2004). They prefer habitats with abundant shrub cover to avoid predation. There are no documented occurrences of this species in the Project Area (WYNDD, 2014).

Black-tailed prairie dog – Black-tailed prairie dogs historically inhabited short-grass and mixed-grass prairies throughout the United States. Many special status wildlife species are found in prairie dog towns, including the black-footed ferret, as well as burrowing owl, mountain plover, and swift fox. There are no documented occurrences of this species in the Project Area (WYNDD, 2014).

In association with the APD applications for the three site-specific well pads, surveys for black-tailed prairie dog colonies were conducted within 0.25-mile of the proposed well pad construction areas (BHEC, 2014a, 2014b, and 2014c). No colonies were identified within the survey areas. At the time of APD processing for the conceptual well pads, additional comprehensive surveys of prairie dog towns would be conducted for each individual well pad.

Long-eared myotis – Relatively little is known about long-eared myotis populations in Wyoming; however, in general, they are found in a wide variety of habitats including grasslands and conifer and deciduous forests (Buseck and Keinath, 2004). There are no documented occurrences of this species in the Project Area (WYNDD, 2014).

Fringed myotis – The fringed myotis is predominantly a western species with documented occurrences in Wyoming (Keinath, 2003). Although little is known about fringed myotis populations, the bat appears to use a broad range of habitats, the most common of which are oak, pinion, and juniper woodlands or ponderosa pine forest at middle elevations. There are no documented occurrences of this species in the Project Area (WYNDD, 2014).

Swift fox – The swift fox occurs in the southeastern portion of the State, where the species is the most common, and also in the south-central and southwestern portions of the State (Dark-Smiley and Keinath, 2003). Swift foxes require large open areas of prairie and grassland habitats. There are four documented occurrences of swift fox within the vicinity of the Project Area (WYNDD, 2014).

Northern goshawk – The northern goshawk is a resident breeder and short distance migrant in Wyoming (Smith and Keinath, 2004). It utilizes a wide variety of habitats including coniferous and deciduous forests. Wintering goshawks may also hunt in open shrub foothills or oak savannahs. There are no documented occurrences of this species in the Project Area (WYNDD, 2014).

Baird's sparrow – The Baird's sparrow is a short- to medium-distance migrant within North America and occurs in eastern Wyoming, mostly during migration. This species is a grassland specialist and requires an area of about 63 hectares (ha) during breeding season (Luce and Keinath, 2003). There are no documented occurrences of this species in the Project Area (WYNDD, 2014).

Sage sparrow – The sage sparrow occurs in the summer throughout most of the State where sagebrush is present (WGFD, 2010). These birds prefer large and undisturbed tracts of tall, dense sagebrush. They are common in Wyoming, but populations are declining. Suitable habitat for this species exists in the Project Area (BHEC, 2014a, 2014b, and 2014c). There are no documented occurrences of this species in the Project Area (WYNDD, 2014).

Burrowing owl – In Wyoming, the burrowing owl's highest concentration is in the south and east, although burrowing owls occur and breed throughout most of the State (WGFD, 2010). This species uses a wide variety of arid and semiarid environments and prefers open prairie, grassland, desert, and shrub-steppes. It may also inhabit agricultural areas. Burrowing owls depend on burrows dug by small

mammals, such as prairie dogs and ground squirrels, for nesting, roosting, and escape. There are no documented occurrences of this species in the Project Area (WYNDD, 2014).

Ferruginous hawk – The ferruginous hawk breeds across a large portion of Wyoming, and some individuals are found during winter in the southern part of the State. This species occupies arid and open grassland, and shrub-steppe (Travsky and Beauvais, 2005). Ferruginous hawks rely on large areas of native grass and shrubs with abundant prairie dogs, other ground squirrels, and jackrabbits. In addition, this species is sensitive to human activities and disturbances during the breeding season and appears to have high site fidelity. There are eight documented occurrences of ferruginous hawks within the vicinity of the Project Area (WYNDD, 2014).

Greater sage-grouse – The greater sage-grouse occurs throughout Wyoming where sagebrush is present. This species depends upon sagebrush habitat. Suitable habitat consists of plant communities dominated by sagebrush and a diverse native grass and forb understory. Suitable winter habitat requires sagebrush above snow (USRB Working Group 2008; Connelly et al. 2004). Abundance has declined, primarily as a result of loss, fragmentation, and degradation of sagebrush habitat.

Greater sage-grouse nesting and early brood-rearing habitat in Wyoming is generally described as sagebrush stands with 15 to 30 percent canopy cover and shrub heights of 11 to 32 inches (40 to 80 centimeters [cm]). Grasses and forbs with height 6 inches (15 cm) or greater and shrub canopy cover greater than 15 percent provide important cover and food for sage-grouse using these habitats. Early brood-rearing habitat has 10 to 25 percent sagebrush canopy cover and a slightly higher canopy cover of grasses and forbs than nesting habitat. Sage-grouse hens with chicks generally use early broodrearing habitat when the chicks range in age from newly hatched up to 21 days of age.

During the spring breeding season, male sage-grouse gather together to perform courtship displays on areas called leks. Greater sage-grouse lek habitat is typically an open area surrounded by potential nesting habitat. The common feature of leks is that they have less shrub and herbaceous cover than surrounding habitats. The sagebrush that surrounds a lek provides important hiding cover from predators for both the male sage-grouse and hens while attending a lek. Sagebrush cover immediately adjacent to a lek may or may not be productive, high-quality nesting habitat. Core areas, or delineated breeding and nesting habitats for core sage-grouse populations in Wyoming, have been defined by the Governor’s Sage-Grouse Implementation Team and local working groups, and approved by the Governor.

Sparse to moderately dense stands of sagebrush with mixed grasses and forbs are present throughout the Project Area and may provide areas of suitable sage-grouse habitat. Based on sagebrush/sage-grouse

habitat GIS data (BLM, 2002), approximately 3,647 acres (19 percent of the Project Area) contains suitable sage-grouse nesting and winter habitat. The Project Area is not located within delineated sage-grouse core areas; however, current sage-grouse mapping identifies one non-core lek within the Project Area. The North Shawnee Lek, located on private land in the southeastern portion of the Project Area, is classified as occupied, although it has been inactive since 2011. Based on Wyoming Natural Diversity Database (WYNDD) occurrence records, there are 72 documented occurrences of greater sage-grouse within the vicinity (approximately 3 miles) of the Project Area (WYNDD, 2014).

In association with the APD applications for the three site-specific well pads, ground surveys to search for signs of sage-grouse were conducted within 2 miles of the proposed well pad and access road construction areas (BHEC, 2014a, 2014b, and 2014c). No sage-grouse were observed during the ground surveys. At the time of APD processing for the conceptual well pads, a comprehensive survey of suitable sage-grouse habitats would be conducted for each individual well pad.

Mountain plover – The mountain plover nests in grasslands, mixed grassland areas, short-grass prairie, shrub steppe, cultivated lands, and prairie dog towns. This species has a narrow range of habitat requirements and appears to have a high degree of site fidelity (Smith and Keinath, 2004). There are no documented occurrences of this species in the Project Area (WYNDD, 2014).

Based on the wildlife surveys conducted for the three site-specific well pads, no suitable habitat for breeding mountain plover was observed within 0.25 mile of the three proposed well pad construction areas (BHEC, 2014a, 2014b, and 2014c). The sagebrush and grassland vegetation was continual with no substantial areas of flat bare ground or vegetation less than 4 inches observed.

Yellow-billed cuckoo – Wyoming lies on the periphery of the yellow-billed cuckoo's range, and most observations of the cuckoo have been transient individuals (Bennett and Keinath, 2003). In Wyoming, yellow-billed cuckoos generally prefer large stands of cottonwood-willow habitat below 7,000 feet, which is typically limited to scattered fragments along major stream drainages. There are no documented occurrences of this species in the Project Area (WYNDD, 2014).

Bald eagle – Bald eagles occur near large lakes and rivers in forested areas where adequate prey and old, large-diameter cottonwood or conifer trees are available for nesting (USFWS, 2004). The bald eagle was delisted from its threatened status under the federal ESA, and in losing federal status, it is designated as sensitive in Wyoming. The bald eagle is protected under the Bald and Golden Eagle Protection Act of 1940 (BGEPA), which prohibits anyone, without a permit issued by the Secretary of the Interior, from taking bald or golden eagles, including their parts, nests, or eggs. The BGEPA defines "take" as pursue,

shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb. There are four documented prior occurrences of bald eagles within the vicinity of the Project Area (WYNDD, 2014).

In association with the APD applications for the three site-specific well pads, surveys for bald eagle nests and winter roosts were conducted within 1 mile of the three proposed well pad construction areas (BHEC, 2014a, 2014b, and 2014c). No bald eagles were observed during the winter roost surveys, and no bald eagle nests were located during the spring raptor nest surveys. At the time of APD processing for the conceptual well pads, additional bald eagle surveys would be conducted for each individual well pad.

Loggerhead shrike – Important habitat characteristics for the loggerhead shrike are the presence of dense shrubs or trees for nesting with nearby open herbaceous areas for foraging (grasslands or pastures) and a high perch density (Keinath and Schneider, 2005). Suitable habitat for this species exists in the Project Area (BHEC, 2014a, 2014b, and 2014c). There are 42 documented occurrences of loggerhead shrikes in the vicinity of the Project Area (WYNDD, 2014).

Long-billed curlew – The long-billed curlew occurs in a variety of grasslands communities, from shortgrass prairies to cultivated hay fields to sagebrush-grasslands (Dark-Smiley and Keinath, 2004). This species has very specific requirements for the habitat characteristics of its breeding, wintering, and foraging habitats. There is one documented occurrence of a long-billed curlew in the vicinity of the Project Area (WYNDD, 2014).

Sage thrasher – The sage thrasher is considered a common summer resident and occurs throughout most of Wyoming where sagebrush is present (WGFD, 2010). Sage thrashers are sagebrush obligates and seem to be quite selective in sites used for nesting and breeding habitat (Buseck et al., 2004). Suitable habitat for this species exists in the Project Area (BHEC, 2014a, 2014b, and 2014c). There are 22 documented occurrences of sage thrashers in the vicinity of the Project Area (WYNDD, 2014).

Brewer's sparrow – The Brewer's sparrow is considered a common summer resident in Wyoming and occurs throughout most of the State (WGFD, 2010). This bird is a sagebrush obligate. Suitable habitat for this species exists in the Project Area (BHEC, 2014a, 2014b, and 2014c). There are 60 documented occurrences of Brewer's sparrow in the vicinity of the Project Area (WYNDD, 2014).

Limber pine – Limber pine is a cold and drought tolerant native tree of western North America, including Wyoming (Natureserve, 2014). It primarily occurs in subalpine forest but may occur on dry, rocky sites at other elevations and in a variety of topographies from gently rolling terrain to cliffs. There are no documented occurrences of this species in the Project Area (WYNDD, 2014).

3.7.5 Migratory Bird Species

The Migratory Bird Treaty Act (MBTA) was implemented for the protection of migratory birds. Unless permitted by other regulations, the MBTA makes it unlawful to pursue, hunt, kill, capture, possess, buy, sell, purchase, or barter any migratory bird, including the feathers or other parts, nests, eggs, or migratory bird products. In addition to the MBTA, Executive Order (EO) 13186 sets forth the responsibilities of federal agencies to further implement the provisions of the MBTA by integrating bird conservation principles and practices into agency activities and by requiring that federal agencies evaluate the effects of actions and agency plans on migratory birds.

The BLM-USFWS Memorandum of Understanding (MOU) (2010) promotes the conservation of migratory birds and guides compliance with EO 13186 (Federal Register V. 66, No. 11). BLM encourages voluntary design features and conservation measures supporting migratory bird conservation, in addition to appropriate restrictions.

Habitats occurring within the Project Area include mixed-grass prairie, ponderosa pine, and Wyoming big sagebrush. Many species of migratory birds use these areas for their primary breeding habitats. Table 3-15 lists the migratory bird species that are likely to occur in Converse County. The Wyoming Bird Conservation Plan identified three groups of high-priority bird species in Wyoming: Level I – those that clearly need conservation action; Level II – species for which the focus is on monitoring, rather than active conservation; and Level III – species that are not a high priority but are of local interest (Nicholoff, 2003). Table 3-12 lists the priority levels for each species. Several migratory species are also BLM sensitive species, including bald eagle, Brewer's sparrow, ferruginous hawk, long-billed curlew, mountain plover, northern goshawk, peregrine falcon, and sage sparrow

Table 3-15: Migratory Birds Potentially Occurring in the Project Area

Common Name	Scientific Name	Primary Habitat Type from Wyoming Bird Conservation Plan	Priority Level from Wyoming Bird Conservation Plan	Wyoming BLM Sensitive
American bittern	*Botaurus lentiginosus*	Wetlands	Level I	No
Bald eagle	*Haliaeetus leucocephalus*	Montane riparian, plains/basin riparian	Level I	Yes
Brewer's sparrow	*Spizella breweri*	Shrub-steppe, mountain-foothills shrub	Level I	Yes
Ferruginous hawk	*Buteo regalis*	Shrub-steppe, shortgrass prairie	Level I	Yes

Common Name	Scientific Name	Primary Habitat Type from Wyoming Bird Conservation Plan	Priority Level from Wyoming Bird Conservation Plan	Wyoming BLM Sensitive
Golden eagle	*Aquila chrysaetos*	Specialized (cliffs)	Level III	No
Long-billed curlew	*Numenius Americana*	Shortgrass prairie, meadows	Level I	Yes
McCown's longspur	*Calcarius mccownii*	Shortgrass prairie	Level I	No
Mountain plover	*Charadrius montanus*	Shortgrass prairie, shrub-steppe	Level I	Yes
Northern goshawk	*Accipiter gentilis*	High elevation conifer, mid elevation conifer, aspen	Level 1	Yes
Peregrine falcon	*Falco peregrinus*	Specialized (cliffs)	Level I	Yes
Prairie falcon	*Falco mexicanus*	Specialized (cliffs)	Level III	No
Sage sparrow	*Amphispiza belli*	Shrub-steppe, mountain-foothills shrub	Level I	Yes
Short-eared owl	*Asio flammeus*	Shortgrass prairie, meadows	Level I	No
Swainson's hawk	*Buteo swainsoni*	Plains/basin riparian	Level I	No
Upland sandpiper	*Bartramia longicauda*	Shortgrass prairie	Level I	No
Western burrowing owl	*Athene cunicularia hypugea*	Shortgrass prairie	Level I	No

Source: Nicholoff, 2003; USFWS, 2014b

4.0 ENVIRONMENTAL EFFECTS

This section describes the potential environmental effects of construction, drilling, completion, production, and maintenance activities associated with the Proposed Action and No Action Alternative, in accordance with 40 CFR 1502.16.

An environmental impact is a change in the quality or quantity of a given resource because of a modification in the existing environment resulting from a project-related activity. Impacts can be beneficial or adverse; a primary (direct) result or a secondary (indirect) result of an action; long-term (more than 5 years) or short-term (less than 5 years); and can vary in degree from a slightly discernible change to a total change in the environment. For the purposes of this EA, a direct impact is one authorized by BLM which occurs at the same time and place. An indirect impact occurs later in time and place after an authorized impact first occurs. For example, a direct impact would be removal of vegetation during grading, while an indirect impact would result if a heavy rain were to occur and erode soil, transporting sediment into streams. Short-term impacts are those that occur within five years of an initial impact and are intended to encompass the time needed to reclaim a site in Wyoming. Long-term impacts are those that would persist past a five-year time frame. These impact definitions are the same as those used in the Casper RMP. Potential impacts are quantified when possible; however, when impacts are not quantifiable, suitable adjectives are used to best describe the level of impact. Relevant mitigation measures are applied where appropriate.

4.1 No Action Alternative

Under the No Action Alternative, oil and gas development would occur on a case-by-case basis. Impacts to air resources, heritage and cultural resources, range management, soils, vegetation, water resources, wildlife and special status species, etc., could occur as a result of surface-disturbing activities and well construction, drilling, completion, and production activities associated with this development. The types of impacts that would result from the No Action Alternative would depend on the intensity of development and would be similar to the types of impacts described below under each resource category for the Proposed Action; however, the impacts would potentially be less intense if the development were smaller scale. Potential impacts would be identified at the time of individual APD submittals (and associated NEPA analysis, if required), and appropriate COAs would be included in the APDs to mitigate impacts that would result from oil and gas development that could be developed under the No Action Alternative.

4.2 Proposed Action

The following sections describe the potential effects of the Proposed Action on the resources discussed in Chapter 3. Each section also includes a discussion of mitigation measures that would be implemented to reduce or avoid the effects of the Proposed Action. Each section concludes with a description of residual effects, defined as any effects from the Proposed Action that would remain after implementation of the mitigation measures.

4.2.1 Air Resources

This section describes the potential effects of the Proposed Action on air quality, visibility, and greenhouse gas emissions.

4.2.1.1 Air Quality and Visibility

The Proposed Action would involve air emissions from construction, drilling, completion, and production activities associated with as many as 32 wells on 6 well pads. Air quality impacts associated with oil and natural gas wells derive from several sources:

- Fugitive dust during well pad construction, during access road construction and improvements, from earth moving equipment, and from vehicular traffic on unpaved roads;
- Suspended particulates (dust) from wind erosion on bare construction areas;
- Hydrocarbon emissions from vehicle engines, drill rigs, heavy equipment related to drilling, and operation of gasoline and diesel engines;
- Gas venting or flaring during well completion and development activities;
- Localized odors and emissions from gas production at well pad sites.

Direct impacts to air quality would result from pollutant emissions of NO_x, CO, SO_2, PM_{10}, and VOCs during construction, drilling and completion activities. Maximum air pollutant emissions from each exploratory well would be temporary, would occur in isolation, and would not significantly interact with adjacent well locations. Temporary construction emissions that occur during well pad construction, well drilling, and well completion testing are estimated in Table 4-1, and are developed from available emission factors, analytical data, anticipated activity, and equipment specifications from APC's experience with similar activities in other locations.

Table 4-1: Per Well Criteria Pollutant Emissions Estimate for a Typical Well in the Project Area – Pad Construction and Drilling/Completion Phases

Project Component	Emissions (tons per year)				
	NO_x	CO	SO_2	PM_{10}	VOC
Pad construction (per 10-acre pad)[1]	2.33	2.87	0.00	0.13	0.34
Drilling and completion	3.13	1.88	0.59	0.11	0.63
Total	5.94	5.1	0.59	0.59	1.01

[1]Emssions from pad construction activities would occur only once for pads with multiple wellbores.

The Proposed Action would also result in direct impacts to air quality as a result of air emissions from operation of the wells. Unlike pad construction and drilling/completion activities that involve standard practices and equipment that can be used to calculate emissions from a Proposed Action, emissions from production activities largely depend on the amount of production from each well. In fields where the operator has experience producing from the underlying formation with a given technology, it is often possible to develop more precise assumptions about the production from new wells. However, in the Project Area, there is limited production data for horizontal wells, making it more difficult to estimate air emissions from the production phase. Data used to calculate the yearly per well emissions for pollutants, as shown in Table 4-2, are from APC exploratory wells near the Project Area. Because these exploratory wells have only been in production for a limited time, APC was unable to determine precise production curves for wells in the Proposed Action. The average production decline curve was estimated using data from similar wells in other APC-operated areas. Emissions presented in Table 4-2 include well production activities associated with heater-treaters, controlled oil flashing, working and breathing losses, fugitives, and truck loading.

Table 4-2: Yearly Criteria Pollutant Per Well Emissions Estimate for a Typical Well in the Project Area – Production Phase[1]

Year	Production Decline[2]	Emissions (tons per year)[3]				
		NO_x	CO	SO_2	PM_{10}	VOC
1	0	0.3	0.2	0.0	0.1	8.1
2	50	0.1	0.1	0.0	0.0	4.0
3	15	0.1	0.1	0.0	0.0	3.4
4	15	0.1	0.1	0.0	0.0	2.9
5	15	0.1	0.1	0.0	0.0	2.5

[1]Emissions information based on average production from APC exploratory wells near the Powder River Basin.
[2]Precise production curves for wells in the Project Area are unknown and were therefore assumed based on a production decline curve for similar well types in other APC-operated areas.
[3]Emissions include well production activities associated with heater-treaters, controlled oil flashing, working and breathing losses, fugitives, and truck loading.

No violations to the NAAQS would be anticipated from implementation of the Proposed Action. Based on information provided herein, localized, short-term, increases in NO_x, CO, VOCs, and PM_{10} concentrations would occur, but maximum concentrations would be well-below applicable State and federal criteria. Air pollutants in the vicinity would return to background levels at the end of operations and would be minimal during the production phase.

Indirect impacts to air quality as a result of the Proposed Action would include decreased visibility in surrounding areas, resulting primarily from vehicle exhaust and increased fugitive dust during construction. Impacts would be localized, and wind dispersion and dilution would result in negligible air quality impacts beyond the well site boundaries. The Proposed Action is not anticipated to impair visibility in federal "Class I" areas (discussed in Section 3.1.2) due to the distance of the Project Area from these protected areas.

In general, air quality impacts from construction, drilling, and completion activities would be short-term (less than 1 year for each well). Air quality impacts from production activities would be long-term and would occur for the duration of the Project.

4.2.1.2 Greenhouse Gas Emissions

The Proposed Action would add as many as 32 new wells on 6 well pads. The Center for Climate Strategies (CCS) prepared the Wyoming Greenhouse Gas Inventory and Reference Case Projection 1990-2020 (Inventory) for the WDEQ through an effort of the Western Regional Air Partnership (CCS, 2007). This report presented a preliminary draft GHG emissions inventory and forecast from 1990 to 2020 for Wyoming. The report estimated that the 2010 total gross carbon dioxide equivalent (CO_2e) emissions for Wyoming would be 60.3 million metric tons (MMt), with the oil and gas industry contributing approximately 12.1 MMt of CO_2e emissions. As of 2010, there were approximately 59,500 producing oil and gas wells in the State (BLM, 2012c). Based on this information, the 2010 per well CO_2e emissions from oil and gas wells within Wyoming was approximately 0.0002 MMt annually (12.1 MMt ÷ 59,500 = 0.0002 MMt), assuming steady production and emissions venting. Based on this estimated emissions factor of 0.0002 MMt per well, if the Proposed Action were selected and if all 32 wells were in production, the Proposed Action could result in additional GHG emissions of approximately 0.006 MMt of CO_2e annually. Over the 45- to 50-year life of the Proposed Action, between 0.27 and 0.30 MMt of CO_2e emissions are expected to be generated.

4.2.1.3 Mitigation

BMPs to reduce emissions from field and production operations, such as those used to reduce fugitive dust emissions, pollutant emissions, and GHG emissions, would help mitigate effects to air quality. Such mitigation measures include:

- Flaring hydrocarbon and gases at high temperatures through the use of multi-chamber combustors in order to reduce emissions of incomplete combustion;
- "Green" (flareless) completions;
- Watering dirt roads during periods of high use to reduce fugitive dust emissions;
- Requiring that vapor recovery systems be maintained and functional in areas where petroleum liquids are stored;
- Installing liquids gathering facilities or central production facilities to reduce the total number of sources and minimize truck traffic;
- Using natural gas-fired or electric drill rig engines;
- Using selective catalytic reducers on diesel-fired drilling engines; and,
- Revegetating areas of the pad not required for production facilities to reduce the amount of dust.

4.2.1.4 Residual Effects

Minor emissions from production could remain during the life of the Proposed Action. However, with implementation of BMPs, air pollution emissions from the Proposed Action would be minimal, and no standards would be violated. GHGs from the Proposed Action would be a minor contribution to the overall emissions in the High Plains area. Residual effects to air quality would be less than significant.

4.2.2 Heritage and Visual Resources

This section describes the potential effects of the Proposed Action on cultural, paleontological, and visual resources.

4.2.2.1 Cultural Resources

All ground disturbing activities associated with the Proposed Action are subject to the recent BLM and SHPO Protocol Agreement (BLM, 2014). The agreement details the cultural resource process of identification, evaluation, effect determination, and mitigation measures for all undertakings. Following the Protocol assures that the BLM will meet its responsibilities under the NHPA. In general, a Class III cultural resource inventory to identify and evaluate any resources present will be conducted prior to authorizing any surface disturbing activities associated with the Proposed Action. Any properties identified that are listed on or eligible for the National Register of Historic Places (NRHP) will either be

avoided through project re-design or have any adverse effects mitigated through a variety of means (see below). Table 1-1 outlines the proposed well pads and number of wells for each pad. Well pads #1, #2, and #3 have had cultural resource inventories conducted, and no significant resources were identified and none will be impacted with those proposed activities. Well pads #4, #5, and #6 are conceptual, and the Protocol process outlined above will be completed prior to authorizing any surface disturbing activities associated with those undertakings.

4.2.2.1.1 Mitigation

In general, three best management practices guide all undertakings. These are, in order of preference: avoid, minimize, and mitigate. Significant sites for cultural resources will be avoided if possible. If sites cannot be avoided, the undertaking will minimize its physical surface imprint and a variety of design and coloring techniques will be implemented to minimize its impact to a no effect or no adverse effect determination. If the previous steps do not achieve a no effect or no adverse effect finding then a mitigation plan will be developed in conjunction with BLM, SHPO, the Advisory Council on Historic Preservation (ACHP), and interested parties.

All BLM permitted activities in the Project Area will contain the following standard cultural resources stipulation:

"The permittee is responsible for informing all persons in the area who are associated with this project that they will be subject to prosecution for knowingly disturbing historic or archaeological sites, or for collecting artifacts. If historic or archaeological materials are uncovered during construction, the operator is to immediately stop work that might further disturb such materials, and contact the AO of the BLM Casper Field Office. Within five working days the AO will inform the operator as to: (1) whether the materials appear eligible for the National Register of Historic Places; (2) the mitigation measures the operator will likely have to undertake before the site can be used (assuming in situ preservation is not necessary); and, (3) a timeframe for the AO to complete an expedited review under 36 CFR 800.11 to confirm, through the State Historic Preservation Officer, that the finds of the AO are correct and that mitigation is appropriate. The AO will provide technical and procedural guidelines for the conduct of mitigation. Upon verification from the AO that the required mitigation has been completed, the operator will then be allowed to resume construction measures."

4.2.2.1.2 Residual Effects

With the incorporation of the specified mitigation section outlined above, there would be little or no residual effects to cultural resources and would, therefore, not be significant.

4.2.2.2 Paleontology

Direct impacts to paleontological resources as a result of the Proposed Action could result from construction activities associated with development of the six well pads and associated facilities. Surface disturbance from construction activities has the potential to uncover and disturb fossil materials. Negative impacts to fossil localities are most likely to occur where construction activities would disturb bedrock outcrop areas. Well pads #2 and #3 are not known to contain important fossil-bearing strata. Well pad #1 is located in an area with a higher potential to contain fossil materials, and surface disturbance activities associated with this well pad could have a higher potential to affect paleontological resources. However, a visual inspection of the well pad #1 site indicates that there are few surface rock outcrops. Indirect impacts to paleontological resources could include erosion of fossil beds due to surface disturbing activities or a potential loss of valuable scientific information as a result of fossil disturbance. Both direct and indirect impacts to paleontological resources would be long-term due to the non-renewable nature of this resource.

4.2.2.2.1 Mitigation

If paleontological resources are discovered due to construction activities, mitigation measures would consist of stabilizing the resource in place and avoiding further disturbance to the fossil resource, developing a strategy to professionally excavate the resource, or developing a plan (after consulting with the operator) to accommodate both the construction activity and protection of the resource.

All BLM-permitted activities in the study area will contain the following standard paleontology stipulation:

“The permittee shall immediately notify the BLM AO of any paleontological resources discovered as a result of operations under this authorization. The permittee shall suspend all activities in the vicinity of such discovery until notified to proceed by the AO and shall protect the discovery from damage or looting. The permittee may not be required to suspend all operations if activities can be adjusted to avoid further impacts to a discovered locality or be continued elsewhere. The AO will evaluate, or will have evaluated, such discoveries as soon as possible, but not later than 10 working days after being notified. Appropriate measures to mitigate adverse effects to significant paleontological resources will be determined by the AO after consulting with the operator. Within 10 days, the operator will be allowed to continue construction through the site, or will be given the choice of either (1) following the AO’s instructions for stabilizing the fossil resource in place and avoiding further disturbance to the fossil resource, or (2) following the AO’s instructions for mitigating impacts to the fossil resource prior to continuing construction through the project area.”

4.2.2.2.2 Residual Effects

With the incorporation of specified mitigation, residual effects to paleontological resources would be less than significant.

4.2.2.3 Visual Resources

Direct impacts to visual resources would include changes to the existing visual landscape of the Project Area from construction, drilling, completion, and production activities associated with the Proposed Action. The removal of vegetation and soil as a result of surface-disturbing activities would be a noticeable, visual change to the landscape. Additional direct impacts would include the presence of construction, drilling, and completion equipment as well as vehicle traffic that would be visible to residents and those traveling through the Project Area. However, the visual intrusions and surface disturbance resulting from the Proposed Action would not contribute to significant changes in the overall visual landscape of the Project Area.

Indirect impacts to visual resources (i.e., overall degradation of the visual character and integrity of the Project Area) are not anticipated, because the visual changes from the Proposed Action would be consistent with the VRM Class IV designation for the area (discussed in Section 3.2.3).

In general, the visual resource impacts from construction, drilling, and completion activities would be short-term, and impacts from production activities would be long-term. Visual intrusions would be reduced during long-term production phases, because fewer facilities, less equipment, less vehicle traffic, etc. would be required for well operation and production. Furthermore, interim reclamation would decrease surface disturbance from approximately 250 acres to 61 acres. This acreage would remain as open disturbance for the life of the Project, after which time facilities would be removed and final reclamation would begin.

4.2.2.3.1 Mitigation

Specific mitigation measures for Project activities on BLM-administered surface land may be developed at the time of APD submittal, in accordance with BLM's Visual Resource Management Manual (MS-8400). The applicant-committed measures for the Project (Appendix A) also include visual resource mitigation measures.

4.2.2.3.2 Residual Effects

The surface disturbance and visual intrusions resulting from the Proposed Action would remain for the life of the project. However, the effect of the Proposed Action on the overall visual landscape of the

Project Area would be minimal. With the incorporation of mitigation measures, residual effects to visual resources would be less than significant.

4.2.3 Range Management

Direct impacts to range management would result from the removal of vegetation due to surface-disturbing activities associated with the Proposed Action. This vegetation removal would potentially result in a reduction in available forage for wildlife and livestock, and a potential loss of 45 BLM AUMs for each affected allotment. However, this reduction in available forage would not adversely impact livestock grazing, because there would be sufficient forage elsewhere in the Project Area to support grazing. Other direct impacts to range management from the Proposed Action would be minimal. APC would work with BLM and ranchers to avoid disturbing existing range improvements, such as fences, gates, and cattle-guards. APC would also work with ranchers to avoid adverse disruptions to ranching operations as a result of increased traffic on roads.

Indirect impacts to range management would potentially result from construction activities and traffic on unpaved roads increasing accumulation of dust on vegetation. The degree of dust accumulation would depend on a variety of factors, such as dust control measures, precipitation events to wash dust off vegetation, wind conditions, time between surface disturbance and reclamation, and frequency of vehicle traffic. The dust accumulation may affect forage palatability and photosynthetic capabilities on vegetation located adjacent to roads and, therefore, indirectly affect the health of livestock from digestion of dust on forage in the area. This in turn could cause grazing lessees to change their management to avoid areas of disturbance. However, it is anticipated that there would be sufficient forage elsewhere in the Project Area to support grazing.

Range management impacts from construction, drilling, and completion activities would be short-term. Range management impacts from production activities would be long-term and would occur for the duration of the Project. Impacts to ranching operations would be reduced in the long-term, because less surface disturbance, fewer facilities, less vehicle traffic, etc. would be required for well operation and production.

4.2.3.1 Mitigation

Mitigation measures for soils and Ecological Sites, discussed in Section 4.2.4.1, and invasive, non-native plant species, discussed in Section 4.2.5.2.1, will be implemented for successful revegetation and reclamation of disturbance areas. The operator will be responsible for reconstructing damaged fences and installing necessary gates or cattle-guards.

4.2.3.2 Residual Effects

Residual effects on range management would be minimal. The reduction in available forage as a result of surface disturbance would not adversely impact livestock grazing due to the presence of sufficient forage elsewhere in the Project Area. Furthermore, reclaimed areas would be available for forage following interim and final reclamation. With the incorporation of specified mitigation measures and the presence of sufficient forage elsewhere in the Project Area, the Proposed Action would result in no significant impacts.

4.2.4 Soils and Ecological Sites

Impacts to soils would result from approximately 250 acres of new soil disturbance in the Project Area during construction, drilling, and completion and approximately 61 acres of new soil disturbance during production. Direct impacts anticipated to occur from the Proposed Action would include soil rutting and mixing, compaction, and increased erosion potential. Indirect impacts would include a corresponding loss of soil structure and soil productivity that results from the direct soil impacts. Following is a more detailed discussion of these direct and indirect impacts.

The majority of impacts to soils would occur in association with the construction of well pads, staging areas, and roads. Construction of these facilities requires grading and leveling, with the greatest level of effort required on more steeply sloping areas. Construction activities mix the soil profiles, resulting in a corresponding loss of soil structure. Mixing may result in removal, dilution, or relocation of organic matter and nutrients to depths where it would be unavailable for vegetative use. Less desirable inorganic compounds such as carbonates, salts, or weathered materials could be relocated and affect revegetation.

Compaction of soils results from the construction of wells and associated facilities, continued vehicle and foot traffic, as well as operational activities. Factors affecting compaction include soil texture, moisture, organic matter, clay content and type, pressure exerted, and the number of passes by vehicle traffic or machinery. Compaction leads to a loss of soil structure; decreased infiltration, permeability, and soil aeration; and increased runoff and erosion.

Increased erosion can lead to a decrease in soil fertility and an increase in sedimentation. The duration and intensity of these impacts would vary according to the type of construction activity to be completed and the inherent characteristics of the soils to be impacted. The potential for erosion would increase through the loss of vegetative cover and soil structure, as compared to an undisturbed state. These impacts would be minimized by rigorous compliance with reclamation plans and mitigation measures discussed below. Soil productivity would decrease, primarily as a result of profile mixing and compaction along

with the loss in vegetative cover. These impacts would begin immediately as the soils would be subjected to grading and construction activities, and impacts would continue for the duration of operations. The impacts on soils would move to a steady state as construction activities are completed and well production/maintenance operations begin.

Rutting affects the surface hydrology of a site as well as the rooting environment. The process of rutting physically severs roots, reducing soil aeration and infiltration, thereby degrading the rooting environment. Rutting may result in topsoil and subsoil mixing, thereby reducing soil productivity. Rutting also disrupts natural surface water hydrology by diverting and concentrating water flow, thus accelerating erosion. Soil mixing typically results in a decrease in soil fertility and a disruption of soil structure.

Table 4-3 shows the direct soil impacts, including acres impacted, soil types, slopes, and erosion potential, for each of the three site-specific well pads. Wind and water erosion potential for the soils at the three well pad sites varies from slight to moderate. Steep slopes are located within the disturbance area for well pad #2. As a result, APC would be required to include appropriate controls at well pad #2 to prevent slope failure and erosion, as discussed below under mitigation.

Table 4-3: Soil Impacts for Site-Specific Well Pads

Well Pad	Initial Surface Disturbance Area	Soil Map Unit Name	Slope	Erosion Potential
Well pad #1	18.3 acres	Kishona-Cambria loams, 0 to 6 percent slopes; Kishona-Cambria-Theedle loams, 3 to 20 percent slopes	0 to 5 percent	Water: Slight Wind: Moderate
Well pad #2	22.33 acres	Shingle-Badland-Samday complex, 10 to 30 percent slopes; Theedle-Kishona-Shingle loams, 3 to 30 percent slopes	2 to 10 percent; >25 percent	Water: Moderate Wind: Slight
Well pad #3 (pre-existing)	22.59 acres	Shingle-Taluce-Badland complex, 10 to 40 percent slopes; Forkwood-Cambria-Cushman loams, 6 to 15 percent slopes	2 to 5 percent; 15 to 20 percent	Water: Moderate Wind: Slight

Source: NRCS, 2014a

As discussed in Section 3.4, approximately 43 percent of the Project Area has slopes greater than 25 percent. Approximately 125 acres within the Project Area (or less than 1 percent) are classified as having the potential for high water erosion. If the conceptual well pads are located in these areas of steep slopes

or high erosion potential, there would be a greater potential for soil impacts, such as slumping, landslides, or erosion. Once specific well pad locations and access roads are defined for the three conceptual well pads, soil impacts, including disturbance of steep slopes and erosion potential, will be determined and evaluated during APD review.

In general, impacts to soils from construction, drilling, and completion activities would be short-term, and impacts from production activities would be long-term and would occur for the duration of the Project. Soil impacts would be reduced in the long-term, because as soon as possible after the initial disturbance, areas not needed for production would be reclaimed.

4.2.4.1 Mitigation

APC would implement appropriate measures to minimize impacts to soils and maintain soil productivity potential to the extent practicable. Topsoil excavated from all disturbed areas would be salvaged, stockpiled, and returned to graded surfaces as an integral part of the construction of all Project elements, thereby reducing the impacts to soil productivity status. Well pads and associated facility disturbances would be re-graded to match existing topography and revegetated following Project termination.

The site-specific reclamation plan associated with each well, road, and pipeline, as well as COAs, mitigation measures, and applicant-committed measures discussed in the COAs will help to reduce the impacts described above. The following resource-specific BLM COAs will be implemented.

- APC will follow the guidance provided in the Wyoming Policy on Reclamation (IM WY-2012-032); for details see http://www.blm.gov/wy/st/en/programs/reclamation.html
- APC will follow the guidance provided in the Wyoming Policy Management of Oil and Gas Exploration and Production Pits (IM WY-2012-007); for details see http://web.wy.blm.gov/Wy.im/12/wy2012-007.pdf
- APC will follow the Record of Decision and Approved Casper Resource Management Plan (BLM, 2007a).
- Except as otherwise provided in an approved Surface Use Plan of Operations, APC will not conduct operations in areas subject to mass soil movement, riparian areas, floodplains, lakeshores, and/or wetlands. APC will also take measures to minimize or prevent erosion and sediment production. Such measures may include, but are not limited to:
    - Avoiding steep slopes and excessive land clearing when siting structures, facilities, and other improvements; and

  - Utilizing erosion control methods such as, but not limited to, revegetating the disturbed areas as soon as possible, erosion control mats, waddles, mulch, hydro-mulch, silt fences, water bars, eyebrow ditches, diversion ditches, wing ditches, gabion baskets or riprap and any other method approved by the AO.
- APC will submit for BLM approval a request on Form 3160–5 before:
  - Undertaking any subsequent new construction outside the approved area of operations; or
  - Reconstructing or altering existing facilities including, but not limited to, roads, emergency pits, firewalls, flowlines, or other production facilities on any lease that will result in additional surface disturbance. If, at the time the original APD was filed, APC elected to defer submitting information under Section III.E.3.d. (Location of Existing and/or Proposed Facilities) of Onshore Order Number One, APC will supply this information before construction and installation of the facilities. The BLM may require a field inspection before approving the proposal. APC will not begin construction until the BLM approves the proposed plan in writing. APC will certify on Form 3160–5 that it has made a good faith effort to provide a copy of any proposal involving new surface disturbance to the private surface owner in the case of split estate.
- Re-seed all disturbed areas with native species adapted to the site conditions and capable of providing protective soil cover. All seed will be certified weed-free. When practical, reseeding of disturbed areas would include the use of locally harvested seed from comparable areas in Wyoming and surrounding states.
- Surface disturbance or development on slopes greater than 25 percent is prohibited, unless individual site plans are submitted to and approved by the AO meeting the following requirements. Engineered drawings for construction, site drainage design, and final rehabilitation contours with a written rationale describing how the proposed controls will prevent slope failure and erosion, while maintaining viable topsoil for final reclamation. This plan would also include a timeline identifying the actions that will be applied during the construction, production, and rehabilitation phases of the plan so appropriate monitoring protocols can be developed by the BLM to check that the plan is meeting the objective described in its rationale.
- Proposed surface-disturbing activities for the conceptual well pads and facilities will be modified (located) to avoid areas of highly erosive soils to the extent practicable. When avoidance of highly erosive soils is not practicable, APC will submit an individual site plan to be approved by the AO meeting the following requirements. Engineered drawings for construction, site drainage design, and final rehabilitation contours with a written rationale describing how the proposed controls will prevent slope failure and erosion, while maintaining viable topsoil for final

reclamation. This plan would also include a timeline identifying the actions that will be applied during the construction, production, and rehabilitation phases of the plan so appropriate monitoring protocols can be developed by the BLM to check that the plan is meeting the objective described in its rationale.

- Soil compaction will be remediated on all compacted surfaces and prior to the redistribution of topsoil on disturbed surfaces to the depth of compaction by methods that prevent mixing of the soil horizons. BLM's recommended methods are subsoiling, paraplowing, or ripping with a winged shank Scarification is acceptable on areas identified as very shallow or shallow soils in the Master Surface Use Plan.
- All pit spoil will be placed back in the pit once the pit is dry or fluids are removed. Subsoil will then be replaced in the reserve pit before topsoiling. Under no circumstances would any by-products from drilling or subsoil be spread on top of topsoil. The pit area would usually be mounded slightly or restored to the original contour to allow for settling and positive surface drainage.
- Earthwork for interim and final reclamation generally will be completed within 6 months of well completion or plugging (weather permitting).

4.2.4.2 Residual Effects

Residual impacts to soils would be minimal after implementation of mitigation measures. The surface disturbance resulting from the Proposed Action would remain until interim and final reclamation are successful. If any minor declines in soil productivity occur, they would be negligible over time.

4.2.5 Vegetation

This section describes the potential effects of the Proposed Action on plant communities and invasive, non-native plant species.

4.2.5.1 Plant Communities

Under the Proposed Action, direct impacts to plant communities would include the removal of 250 acres of vegetation in the short-term and the removal of 61 acres of vegetation in the long-term. The affected plant communities consist of common vegetation types (i.e., mixed-grass prairie, ponderosa pine, Wyoming big sagebrush) and are abundant throughout the Project Area. Indirect impacts may include vegetation loss from oil spills, dust emissions, and the introduction of noxious weeds and non-native plant species. Dust deposited on plants may reduce plant vigor, productivity, and health. Over time, plant diversity and communities may change. The extent of the impacts would depend on plant sensitivity, type

and timing of Project activities, acres of disturbance (both long-term and short-term), and physical parameters.

Short-term impacts would result from the temporary removal of vegetation as a result of construction activities from well pads, ancillary facilities, road, and pipelines. Long-term impacts would include long-term loss of vegetation associated with operation and maintenance activities of well pads and roads.

4.2.5.1.1 Mitigation

Following completion of construction and drilling, APC would implement interim reclamation plans for each of the proposed well pads in order to restore site stability and revegetate disturbed areas to provide a self-sustaining and productive use of the land during production operations (interim reclamation phase). After final plug and abandonment has commenced, APC would implement the final reclamation phase in order to restore the native characteristics of the site. The following mitigation measures will be implemented to protect vegetative resources:

- Disturbed areas will be revegetated with approved, weed-free seed mixes. Site specific seed mixtures will be approved by the AO.
- Disturbed areas will be kept as free of noxious weeds and undesirable species as practicable during construction, production, and reclamation operations.
- Vehicles and equipment will be required to arrive at the work site clean, power-washed, and free of soil and vegetative debris capable of transporting weed seeds or other propagules.

4.2.5.1.2 Residual Effects

Residual effects on plant communities would be less than significant after implementation of mitigation measures. The removal of vegetation as a result of surface disturbance would remain for the life of the project. However, plant communities would not be adversely impacted, because vegetation types are common and found in abundance throughout the Project Area. Vegetation would be reestablished following interim and final reclamation.

4.2.5.2 Invasive, Non-Native Plant Species

An indirect impact on vegetation from the Proposed Action would include the introduction of noxious weeds and non-native plant species as a result of surface-disturbing activities. Disturbed surfaces would potentially create a favorable environment for the establishment and spread of noxious weeds/invasive plants. Machinery could also bring non-native species to the area along newly developed access roads.

Under the Proposed Action, 250 acres would be disturbed in the short-term. Approximately 189 acres of this disturbance would undergo interim reclamation utilizing native seed species. The final 61 acres would remain disturbed in the long-term and would be reclaimed after the 45- to 50-year expected life of the Project.

4.2.5.2.1 Mitigation

APC would implement integrated weed and pest management plans for each of the proposed well pads in order to control the spread of noxious weeds throughout construction, production, and reclamation of the Project. APC will provide a pesticide utilization proposal (PUP) and an integrated pest management plan (IPMP) as part of the complete APD package if any part of the Project is located on BLM-administered surface. In the case of split estate, APC will include the IPMP within the surface use agreement with the private surface owner.

Fencing the well pads off from livestock grazing for 2 years after seeding and weed control will give the vegetation a chance to germinate and establish in the disturbed areas.

All surface disturbance not utilized in the running surface of the road or active production areas would have interim reclamation performed. All vehicle traffic would be kept to the running surface or actively used acres of disturbance in order to prevent the transport of invasive, non-native plant species.

Control methods for invasive, non-native plant species include physical, biological, and chemical methods.

- Physical methods include mowing during the first season vegetation is established, prior to seed formation, and hand pulling weeds in small or new infestations.
- Biological methods include the use of domestic animals, or biological agents that have been approved by the AO.
- Chemical methods include the use of approved herbicides applied in accordance with the PUP or the surface use agreement with the private surface owner.

4.2.5.2.2 Residual Effects

With implementation of IPMPs and mitigation measures, the establishment and spreading of invasive, non-native plant species would be avoided. Therefore, no residual effects are anticipated.

4.2.6 Water Resources

This section describes the potential effects of the Proposed Action on groundwater and surface water resources. The mitigation and residual effects discussions are combined for both groundwater and surface water resources and are included at the end of this section.

4.2.6.1 Groundwater

Under the Proposed Action, 32 wells on 6 well pads would be drilled. Groundwater resources could be directly impacted by the Proposed Action from increased water usage for construction and operations (drilling, completion, and dust suppression). As described in Section 2.0, the Proposed Action could use an estimated 2.6 to 3.2 million bbls of water over the life of the Project for drilling and completion if all 32 wells are completed. In addition, an estimated 9,680 bbls of water per day may be required in the short-term for dust abatement, assuming all 250 acres of short-term disturbance require abatement. For the site-specific wells (well pads #1, #2, and #3), APC plans to obtain water for drilling and completions from the Shawnee water load out facility/staging area. For the conceptual wells (well pads #4, #5, and #6), water would be acquired from an already appropriated source or from a new water well permit (issued by WSEO to appropriate groundwater).

Indirect impacts to groundwater quality would be minimized, because APC would take actions to avoid spills of fuel or other contaminants, in compliance with applicable State and federal regulations.

Water usage for drilling and completion and for dust suppression during construction would be a short-term impact. No long-term impacts to water quantity or quality are anticipated from the Proposed Action.

4.2.6.2 Surface Water and Wetlands

Direct impacts to surface waters would be minimal and would primarily occur where culverts would be installed for upgraded or new roads. The Proposed Action could result in indirect impacts to surface water in association with surface disturbance. Under the Proposed Action, approximately 250 acres would be disturbed in the short-term and 61 acres would be disturbed in the long -term. This surface disturbance could result in increased erosion and sedimentation in creeks and drainages. Sediment from soil erosion in disturbed areas could be transported via surface water flow into drainages. Surface waters would be most susceptible to sedimentation during construction, drilling, and completion activities, particularly when culverts are installed. However, to avoid adverse impacts to surface water from erosion and sedimentation, APC would comply with the Clean Water Act for all surface disturbances and would operate under a storm water pollution prevention plan (SWPPP).

In general, surface water impacts from construction, drilling, and completion activities would be short-term. Surface water impacts from production activities would be long-term and would occur for the duration of the Project.

4.2.6.3 Mitigation

APC would implement appropriate water management actions to protect groundwater resources in compliance with applicable State and federal regulations. As stated in Section 2.2, a closed loop drilling mud system would prevent any shallow groundwater contamination. Adherence to the drilling applicant committed measures in Appendix A and any additional COAs required by the BLM for individual wells, the setting of casing at appropriate depths, following safe remedial procedures in the event of casing failure, and using proper cementing procedures would protect ground water resources from contamination. Compliance with the drilling and completion plans and Onshore Oil and Gas Orders Nos. 2 and 7 would also help avoid adverse impacts on groundwater. The potential for spill from fuels or other contaminants that could affect surface water quality would be minimized by implementing BMPs and a Spill Prevention, Control, and Countermeasure (SPCC) plan, and by complying with other State and federal regulations.

In order to minimize the overall impact to groundwater and surface water resources within the Project Area that could result from the Proposed Action, the following mitigation measures will be implemented:

- Wells will have surface casing set and cemented to isolate the water bearing zones according to State and local agencies and the BLM AO.
- To reduce the potential for sediment transport in surface water runoff, well pads and access roads will be located, engineered, and constructed to minimize sediment load in surface water runoff.
- Road drainage crossings (culvert installations) will be of the typical dry creek drainage crossing type. Crossings will be designed so they do not cause siltation or accumulation of debris in the drainage crossing. The roadbed would not block the drainages.
- Erosion of drainage ditches by runoff water will be prevented by diverting surface water at frequent intervals by use of cutouts. Subsequent reclamation activities would substantially reduce surface exposure and therefore decrease long-term impacts on surface waters.
- BMPs and a SWPPP will be implemented to minimize impacts to water quality.
- A watershed analysis has been completed for site-specific submitted APDs and will be completed for the conceptual APDs for each crossing to assess whether a culvert is needed and, if so, the proper sizing.

4.2.6.4 Residual Effects

Residual impacts to groundwater and surface water resources would be less than significant after implementation of mitigation measures and compliance with applicable State and federal regulations.

4.2.7 Wildlife, Special Status Species, and Threatened and Endangered Species

This section describes the potential effects of the Proposed Action on big game species, raptors, threatened and endangered species, BLM sensitive species, and migratory birds. The mitigation and residual effects discussions are combined for all wildlife and special status species and are included at the end of this section.

4.2.7.1 Big Game Species

As discussed in Section 3.7.1, pronghorn, mule deer, elk, and white-tailed deer are the most probable big game species to occur within the Project Area. Direct effects to big game species from initial Project construction would likely be minimal, because the animals could simply move away from the activity. Indirect effects could include habitat loss associated with surface disturbance from construction of wells, road, facilities, pipelines and other ancillary components of the Proposed Action. No impacts to crucial winter range or parturition areas would occur for any big game species. Other indirect impacts to big game species include dispersal of noxious and invasive weed species in forage areas, dust effects from unpaved road traffic, alterations in hunting and/or poaching, increased vehicle collisions, harassment and displacement, increased noise, alterations in nutritional status and reproductive success, increased fragmentation, loss or degradation of habitats, reduction in habitat effectiveness, and resulting declines in populations.

Impacts to big game species from construction, drilling, and completion activities would be short-term, and impacts from production activities would be long-term. Big game species impacts would be reduced during production phases, because less surface disturbance, vehicle traffic, human presence, etc. would be required for well operation and production. Interim reclamation would decrease surface disturbance from approximately 250 acres to 61 acres, which would remain as open disturbance for the life of the Project.

4.2.7.2 Raptors

A number of raptor species (e.g., golden eagle, ferruginous hawk, prairie falcon, redtailed hawk, Swainson’s hawk, and great-horned owl) seasonally occupy habitats found within the Project Area. Direct effects to raptors are not anticipated, because the Project would avoid impacting active nesting sites. Indirect impacts to raptors as a result of the Proposed Action would include disturbance of approximately

250 acres in the short-term and 61 acres in the long-term of potential nesting and/or foraging habitat for raptor species. The loss or alteration in habitat, reduction in prey base, and increased human disturbance could result in lower raptor densities.

Raptors breeding in or adjacent to the Project Area could abandon breeding territories or nest sites and lose eggs or young because of construction and operation activities occurring during the breeding season (February 1 to July 31). However, adverse impacts would be avoided, because active nesting sites would be monitored, and construction or disturbance would be avoided at these locations until the nesting season is past. Future nest sites and foraging habitat would be influenced by surface disturbing activities and increased human presence within the Project Area.

As is the case with big game species, impacts to raptors from construction, drilling, and completion activities would be short-term, and impacts from production activities would be long-term.

4.2.7.3 Threatened and Endangered Species

As discussed in Section 3.7.3, seven species federally listed as endangered or threatened have the potential to occur in the Project Area or to be affected by the Project. Following is a discussion of the potential for the Proposed Action to affect these species.

Ute ladies'-tresses – As discussed in Section 3.7.3, suitable habitat for Ute ladies'-tresses is not located in the Project Area. Therefore, there would be no effect on this species.

Preble's meadow jumping mouse – As discussed in Section 3.7.3, suitable habitat for Preble's meadow jumping mouse is not located in the Project Area. Therefore, there would be no effect on the Preble's meadow jumping mouse.

Species affected by North Platte River water depletions – The five North Platte species identified in Section 3.7.3 (interior least tern, piping plover, pallid sturgeon, whooping crane, and western prairie-fringed orchid) that may occur in the downstream riverine habitats of the Platte River in Nebraska could be adversely affected by surface water depletions (consumption) in the North Platte River system resulting from Project-related activities. Water for the Proposed Action would be obtained from the Shawnee water load out facility/staging area located in NENW, Section 9, Township 32N, Range 68W. The facility is located in the North Platte River basin; however, it is not located in an area that is hydrologically connected to the Platte River system (USFWS, 2007; WSEO, 2004). Therefore, there would be no effect to North Platte River Species. Consultation with USFWS will occur if water for the

conceptual wells is obtained from a hydrologically connected sub-basin to the Platte River system and exceeds 0.1 acre-foot per year.

4.2.7.4 BLM Sensitive Species

As discussed in Section 3.7.4, 20 BLM sensitive species may be potentially found in the Project Area. Under the Proposed Action, the construction, drilling, completion, and production activities could result in impacts to BLM sensitive species, as described below.

White-tailed and black-tailed prairie dogs – Direct impacts to prairie dog species could include mortalities of individuals as a result of crushing from construction activities, vehicles, and equipment. No known prairie dog towns (white-tailed or black-tailed) occur within or in the vicinity of the Project Area. Therefore, no direct impacts to prairie dogs are anticipated from surface disturbing activities associated with the Proposed Action. Indirect impacts could result from increased habitat fragmentation, human presence, and noise.

Swift fox – Direct effects to swift fox from initial Project construction would likely be minimal, because the animals could simply move away from the activity. Indirect impacts to swift fox would include displacement related to construction and operation; habitat loss, alteration, and fragmentation; and increased levels of noise, activity, and human presence. Project construction and operation on previously undisturbed lands would result in the loss of potential habitat, until reclamation was completed and vegetation re-established. Impacts also could include temporary displacement of swift fox from areas with surface disturbance, due to the short-term and long-term loss of vegetation. Given the availability of habitat elsewhere in the Powder River Basin and High Plains, the proposed activities would not likely result in a trend towards decline of the species.

Burrowing owl – Direct effects to burrowing owls are not anticipated, because the Project would avoid impacting active breeding or nesting sites. Indirect impacts of the Proposed Action would be a reduction in the amount of suitable habitat for burrowing owls as a result of surface disturbance. Well drilling and other human activities (both directly and indirectly associated with the Proposed Action) would incrementally reduce the productivity of the habitats and increase the amount of human presence within the Project Area. Other indirect negative impacts could include displacement from foraging areas and reduction of prey species. Given the availability of habitat elsewhere in the Powder River Basin and High Plains, the proposed activities would not likely result in a trend towards decline of the species.

Greater sage-grouse – As discussed in Section 3.7.3, there is one non-core greater sage-grouse lek located in the Project Area, and suitable winter habitat was identified in the Project Area during surveys.

Direct impacts to greater sage-grouse are not anticipated, because the Project would avoid impacting active nesting sites. Indirect impacts on greater sage-grouse as a result of the Project would include a loss of potentially suitable breeding or winter habitats from surface disturbance; increased habitat fragmentation from development of well pads and roads; disturbance from increased noise levels and human presence; and reduction in habitat quality due to dispersal of noxious and invasive weed species. The invasion of weeds could compete with important native species of plants that provide both cover and food for greater sage-grouse. Project-related activities could also lead to increased vehicle collision potential as well as increased predation by raptors, corvids, and coyotes because of decreased sagebrush vegetation cover associated with surface-disturbing activities. Because the proposed Project would comply with sage-grouse mitigation measures discussed below and because the Project is outside of core population areas, impacts to the sage-grouse would not be significant.

Mountain plover – Direct effects to burrowing owls are not anticipated, because the Project would avoid impacting active nesting sites. Indirect impacts from the Proposed Action include disturbances to mountain plovers using breeding and foraging habitat in the Project Area; loss of grassland-low shrub habitat suitable for reproduction and foraging; and timing of surface-disturbing actions and increased human presence during sensitive breeding and nesting periods. These impacts could cause individual breeding pairs to abandon the area and/or nest and young, choosing other areas. Indirect impacts could also include increased inter- and intra-species competition for suitable breeding and foraging sites elsewhere within the grassland habitats in the Project Area and surrounding areas.

Limber pine – Tree clearing activities associated with surface disturbance could result in direct impacts to limber pine. However, because limper pine is a subalpine species and none have been documented in the Project Area, no direct or indirect effects to the limber pine are anticipated from the Proposed Action.

Bats – Potentially suitable foraging habitat for the Townsend's big-eared bat, long-eared myotis, and fringed myotis occurs in the Project Area. Surface-disturbing activities that require tree clearing could reduce potential foraging and roosting habitat, resulting in indirect impacts to these bat species. However, the total loss of habitat would be less than significant, and impacts to the bat would be negligible.

Raptors – Impacts to bald eagles and ferruginous hawks would be the same as those described under Section 4.2.7.2.

Migratory birds – Impacts to Northern goshawk, Baird's sparrow, sage sparrow, yellow-billed cuckoo, loggerhead shrike, long-billed curlew, sage thrasher, and Brewer's sparrow populations would be the same as those described under Section 4.2.7.5.

4.2.7.5 Migratory Bird Species

Numerous species of migratory birds, including passerines, may forage or nest in or near the Project Area. Direct effects to migratory birds are not anticipated, because the Project would avoid impacting active nesting sites. Indirect impacts as a result of surface-disturbing activities from the Proposed Action would include a loss of potential nesting and foraging habitats for migratory birds. Other indirect impacts to migratory birds associated with the Proposed Action would depend on seasonal timing of construction, drilling, and completion activities. If these activities were conducted in the late fall, many of the migratory species would have left the Project Area for southern wintering grounds. Surface disturbance and visual and noise impacts during non-nesting season would not affect most individual birds or nesting locations. However, if construction activities were to occur during the spring or summer months, they could discourage nesting pairs from establishing nests or cause nest abandonment. Associated noise and increased human presence could also cause displacement from foraging and nesting habitats. However, given the availability of habitat elsewhere in the Powder River Basin and High Plains, the Proposed Action would not likely result in a trend towards decline of migratory birds.

Impacts to raptors from construction, drilling, and completion activities would be short-term, and impacts from production activities would be long-term. Successful interim and final reclamation, in conjunction with weed control efforts, would help to restore the needed forage and cover types required by migratory birds over time.

4.2.7.6 Mitigation

To minimize the overall impacts to wildlife, special status species, and threatened and endangered species within the Project Area that could result from the Proposed Action, the following mitigation measures will be implemented:

- From March 1 to May 15, surface-disturbing activities will be prohibited within a 0.25-mile radius of occupied sage-grouse leks, and disruptive activities will be restricted within a 0.25-mile radius of occupied or undetermined sage-grouse leks from 6 pm to 8 am.
- From March 15 to July 15, surface disturbing and/or disruptive activities will be restricted in sage-grouse nesting and early brood-rearing habitat within 2 miles of an occupied sage-grouse lek.
- Surface-disturbing and/or disruptive activities will be restricted within a 0.5-mile radius of active raptor nests from February 1 to July 31 or until the chicks have fledged. A 0.25-mile radius will be used for the following species: red-tailed hawk, Swainson’s hawk, American kestrel, osprey,

great horned owl, long-eared owl, Northern saw-whet owl, common barn owl, Western screech owl.

- Overhead power lines shall be designed, constructed, and installed in accordance with the standards outlined in *Suggested Practices for Raptor Protection on Power Lines: the State of the Art in 2006* (APLIC, 2006).
- From April 10 to July 10, surface-disturbing and/or disruptive activities will be restricted within a 0.25-mile radius of the proposed activities if suitable mountain plover breeding or nesting habitat is located within this buffer.
- Surface-disturbing and disruptive activities will be designed in a manner that avoids prairie dog towns and complexes. Where this is impractical, the disturbance would be located to minimize impact to prairie dogs.
- Surface development will be restricted within an area ranging from 0.5- to 1-mile of known or discovered bald eagle nests. The specific distance and dimensions of the area on which surface development will be restricted will be determined on a case-by-case basis. Surface development or use will be prohibited on all public lands and minerals within designated bald and golden eagle winter roosts. Disruptive activities will be restricted from November 1 to March 31 for habitat improvement projects.
- Surface development or use will be restricted within designated critical habitat for threatened or endangered species. In areas known or suspected to contain habitat for threatened and endangered species and/or special status species, inventories, surveys, or monitoring will be conducted to verify the presence of special status species.

4.2.7.7 Residual Effects

With the incorporation of specified mitigation, residual effects to wildlife and sensitive species would be less than significant.

5.0 CUMULATIVE EFFECTS

CEQ regulations require an assessment of potential cumulative impacts. Cumulative impact is defined by those regulations at 40 CFR 1508.7 as "the impact on the environment which 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 taking place over a period of time."

Potential cumulative impacts for each affected resource are assessed in this section. The discussion of potential cumulative impacts assumes the successful implementation of the environmental protection and mitigation measures described in Section 4.0, as well as compliance with the Casper RMP and applicable federal, State, and local regulations and permit requirements.

The area over which cumulative impacts are evaluated may vary by resource, as appropriate. For most terrestrial resources, the area assessed encompasses the Pine Scoria Hills ecoregion. For air quality, the area assessed for cumulative effects includes the High Plains District jurisdictional area. For surface water resources, the area assessed includes the Glendo Reservoir and Lightning Creek watersheds.

The past, present, and reasonably foreseeable future actions (RFFAs) that have affected or may affect resources in the Cumulative Impacts Area (CIA) include oil and gas development that is occurring or is planned to occur under the East Converse EA (BLM, 2012), which includes part of the Pine Scoria Hills Ecoregion. This development includes 264 acres of short-term and 153 acres of long-term surface disturbance associated with 18 well pads for 72 wells. Table 5-1 includes a comparison of the cumulative impacts of these past, present, and RFFAs when added to the impacts of the No Action and Proposed Action Alternatives.

Table 5-1: Cumulative Effects for the Mohawk EA

Resource	Cumulative Increment	No Action Alternative (case-by-case well development)	Proposed Action (32 wells on 6 well pads)
Air Resources	*Past, Present, RFFA (+)*	The 72 wells included in the past, present, and RFFAs would produce air emissions and an estimated 0.014 MMt of greenhouse gas (GHG) emissions annually from construction, drilling, completion, and production activities.	
	Incremental Effect of Alternatives (+)	The No Action Alternative would result in air emissions and GHG emissions from construction, drilling, completion, and production of future wells.	The Proposed Action would result in air emissions and an estimated 0.006 MMt of GHG emissions annually from construction, drilling, completion, and production of the 32 wells.
	Total by Alternative (=)	Air emissions and GHG emissions from construction, drilling, completion, and production of 72 wells and the future wells developed on a case-by-case basis under the No Action Alternative would be produced within the High Plains District.	Air emissions from construction, drilling, completion, and production of 104 wells would be produced within the High Plains District. The 104 wells could produce 0.020 MMt of GHG emissions annually.
Range Management; Soils and Ecological Sites; Vegetation; Invasive, Non-Native Species	*Past, Present, RFFA (+)*	The 72 wells included in the past, present, and RFFAs would result in 253 acres of short-term and 153 acres of long-term surface disturbance.	
	Incremental Effect of Alternatives (+)	Impacts include the removal of vegetation, loss of available forage, and introduction of invasive, non-native species as a result of surface disturbance. The No Action Alternative would result in surface disturbance from construction, drilling, completion, and production of future wells.	Impacts include the removal of vegetation, loss of available forage, and introduction of invasive, non-native species as a result of surface disturbance. The combined surface disturbance for construction, drilling, completion, and production of the 32 wells would yield a total of 250 acres of disturbance in the short-term and 61 acres in the long-term.
	Total by Alternative (=)	Surface disturbance from construction, drilling, completion, and production of 72 wells and future wells developed on a case-by-case basis under the No Action Alternative would be produced within the Pine Scoria Hills Ecoregion.	Within the Pine Scoria Hills Ecoregion, there would be an estimated combined short-term surface disturbance of 503 acres and a long-term surface disturbance of 214 acres from the construction, drilling, completion, and production of 104 wells.

Resource	Cumulative Increment	No Action Alternative (case-by-case well development)	Proposed Action (32 wells on 6 well pads)
Water Resources	*Past, Present, RFFA (+)*	The 72 wells included in the past, present, and RFFAs would use an estimated 5.8 to 7.2 barrels (bbls) of water in the long-term and would result in 253 acres of short-term and 153 acres of long-term surface disturbance.	
	Incremental Effect of Alternatives (+)	Impacts to groundwater occur through actual water usage. The No Action Alternative would use an estimated 80,000 to 100,000 bbls of water for drilling and completion of each future well approved on a case-by-case basis. In addition, 0.028 gallons of water per square foot of disturbance would be required for dust abatement per day. Impacts to surface water occur with surface disturbance. This alternative would result in additional short-term and long-term disturbance from development of the future wells.	Impacts to groundwater occur through actual water usage. This alternative would use an estimated 2.7 to 3.2 million bbls of water for drilling and completion of the 32 wells. An additional 9,680 bbls of water per day would also be required in the short-term for dust abatement. Impacts to surface water occur with surface disturbance. This alternative would result in a total of 250 acres of short-term and 61 acres of long-term disturbance from development of the 32 wells.
	Total by Alternative (=)	Drilling and completion of 72 wells and future wells developed on a case-by-case basis would use water from the Glendo Reservoir and Lightning Creek Watersheds.[1] Surface disturbance from construction, drilling, completion, and production of 72 wells and future wells developed on a case-by-case basis under the No Action Alternative would be produced.	An estimated 8.5 to 10.4 million bbls of water from the Glendo Reservoir and Lightning Creek Watersheds would be used in the long-term for 104 wells.[1] There would be an estimated combined short-term surface disturbance of 503 acres and a long-term surface disturbance of 214 acres from the construction, drilling, completion, and production of 104 wells.

Resource	Cumulative Increment	No Action Alternative (case-by-case well development)	Proposed Action (32 wells on 6 well pads)
Wildlife, Special Status Species, and Threatened and Endangered Species	*Past, Present, RFFA (+)*	The 72 wells included in the past, present, and RFFAs would result in 253 acres of short-term and 153 acres of long-term surface disturbance and loss of wildlife habitat.	
	Incremental Effect of Alternatives (+)	Impacts include the loss of wildlife habitat as a result of surface disturbance. Impacts to special status species and threatened and endangered species would be minimized through the implementation of mitigation measures. The No Action Alternative would result in surface disturbance from construction, drilling, completion, and production of future wells.	Impacts include the loss of wildlife habitat as a result of surface disturbance. Impacts to special status species and threatened and endangered species would be minimized through the implementation of mitigation measures. The short-term combined surface disturbance for construction, drilling, completion, and production of the 32 wells would yield a total of 250 acres of disturbance. The long-term combined surface disturbance, with consideration for reclamation, would yield a total of 61 acres of disturbance over the life of the project.
	Total by Alternative (=)	Surface disturbance from construction, drilling, completion, and production of 72 wells and future wells developed on a case-by-case basis under the No Action Alternative would be produced within the Pine Scoria Hills Ecoregion.	Within the Pine Scoria Hills Ecoregion, there would be an estimated combined short-term surface disturbance of 503 acres and a long-term surface disturbance of 214 acres from the construction, drilling, completion, and production of 104 wells.

[1]Assumes that all water used for the Project originates in the Glendo Reservoir or Lightning Creek Watersheds.

6.0 LIST OF PREPARERS

Table 6-1 identifies the personnel responsible for the preparation of this EA.

Table 6-1: List of EA Preparers

Name	Agency/Firm	Title
Jennifer Bell	Burns & McDonnell	NEPA Specialist
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APPENDIX A - APPLICANT-COMMITTED MITIGATION MEASURES

APPENDIX A – APPLICANT COMMITTED MEASURES

This appendix presents Anadarko Petroleum Corporation's (APC's) measures to avoid and mitigate potential impacts from the Mohawk Oil and Gas Exploration and Development Project. For a detailed description of the design features and construction practices associated with the Proposed Action, refer to Section 2.0 of this Environmental Assessment (EA). Additional applicant-committed measures are incorporated in the Integrated Weed and Pest Management Plan (Appendix B).

Surface Disturbance:

1. Improved roads used in conjunction with accessing project wells must be fully built (including all water control structures such as wing ditches, culverts, relief ditches, low water crossings, surfacing, etc.) and functional to Bureau of Land Management (BLM) standards as outlined in the BLM Manual 9113 prior to drilling of the well. This applies to the entire project area.
2. Erosion control fabric used for reclamation of steep slopes will be photodegradable or biodegradable to limit the amount of debris/trash on and around each location. All erosion control products will be applied according to manufacturer's specifications to reduce product failures.
3. A 20-foot undisturbed vegetative buffer must be maintained between the edge of disturbance and adjacent head cuts and steep drainages, as determined by the BLM Authorizing Officer (AO).
4. In most cases, short-term stabilization measures to help protect soil from erosion will be performed within 30 days from the start of construction, unless otherwise identified as such to the BLM AO.
5. The applicant will follow the guidance provided in the Wyoming Policy on Reclamation (Instruction Memorandum WY-2012-032). The Wyoming Reclamation Policy applies to all surface-disturbing activities. Authorizations for surface-disturbing actions are based upon the assumptions that an area can and ultimately would be successfully reclaimed. BLM reclamation goals also include the short-term goal of quickly stabilizing disturbed areas to protect both disturbed and adjacent undisturbed areas from unnecessary degradation.
6. Before replacing topsoil on disturbed surfaces, and on all other compacted surfaces, compaction will be remediated by ripping to the depth of compaction. Scarification will be used on shallow soils.
7. Drill cuttings generated through the drilling of the well will be stored in a bermed and lined area. They will be tested and buried onsite in accordance with Wyoming Oil and Gas Conservation Commission (WOGCC) guidance and upon BLM approval. Any change of plans for cuttings disposal will be submitted in the form of a sundry for BLM approval.

8. Once the well pad location has been re-contoured and top soil spread for interim reclamation, all areas not used for production operations will be seeded and stabilized. Seeding will be done on the contour and at the appropriate depth for species (not to exceed 0.5 inch). Certified weed-free seed will be used on all sites unless otherwise specified by surface management agency/owner. Site specific evaluation will determine the overall seed mixture in conjunction with the BLM or private surface owner.

Water:

1. The operator will collect a water sample representative of the water produced from this project area for analysis within 30 to 60 days of initial production. Results of the analysis will be submitted to the BLM AO as soon as they become available. The constituents analyzed in the water quality analyses will be the same as those required by the Wyoming Department of Environmental Quality (WDEQ) for Wyoming Pollutant Discharge Elimination System (WYPDES) permit using approved U.S. Environmental Protection Agency (EPA) test procedures (40CFR136 or 40CRF136.5).
2. After well completion, the operator shall submit a Sundry Notice for approval of disposal of all produced water in accordance with Onshore Oil and Gas Order No. 7, Disposal of Produced Water.

Drilling and Production Operations:

1. Verbal notification shall be given to the AO at least 24 hours before formation tests, blowout prevention (BOP) tests, running, and cementing casing, and drilling over lease expiration dates.
2. Rotation of new hard-band pipe inside casing will be minimized. Hard-band drill pipe shall be considered new until it has been run at least once.
3. All BOP equipment tests shall include a 5 minute low pressure test between 250 pounds per square inch (psi) and 500 psi with no drop in pressure with the only exception being the chokes. The chokes are only required to have the high pressure test held for a minimum length of time necessary to verify their functional integrity.
4. All operations must be conducted in accordance with all applicable laws and regulations: with the lease terms, Onshore Oil and Gas Orders, Notices to Lessees (NTL's); and with other orders and instructions of the AO, unless a variance has been granted in writing by the AO.
5. The Operator shall install an identification sign consistent with the requirements of 43 CFR 3162.6 immediately upon or before the completion of the well pad construction operations.
6. All BOP equipment rated 5M or greater shall be isolated from the casing and tested to stack working pressure. All BOP equipment tests shall be performed by a suitable test pump, not the

rig-mud pumps and recorded on a chart. The chart shall be submitted to the BLM Casper Field Office (CFO).

7. Low test on BOP equipment shall be performed and passed before moving onto the high test for each component.
8. If there are indications of inadequate primary cementing of the surface, intermediate, or production casing strings; such as but not limited to insufficient returns, cement channeling, fallback or mechanical failure of equipment, the operator will evaluate the adequacy of the cementing operations. This evaluation will consist of running a cement bond log (CBL) or an alternate method approved by the AO.
9. If the evaluation indicates inadequate cementing, the operator shall contact a BLM CFO Petroleum Engineer for approval of remedial cementing work.
10. The adequacy of the remedial cementing operations shall be verified by a CBL or an alternate method approved by the AO. All remedial work shall be completed and verified prior to drilling out the casing shoe or perforating the casing for purposes other than remedial cementing.
11. The cement mix water used must be of adequate quality so as not to degrade the setting properties of the cement. Any water that does not meet municipal quality water standards shall be tested by mixing the water and cement in a lab and comparing the results to the municipal quality water mix results. If the results show that the cement qualities are not the same or greater, than the nonmunicipal water shall not be used for mixing cement in the well.
12. All oil and gas operations shall be conducted in a manner to prevent the pollution of all freshwater resources. All fresh waters and waters of present or probable future value for domestic, municipal, commercial, stock or agricultural purposes will be confined to their respective strata and shall be adequately protected. Special precautions will be taken to guard against any loss of artesian water from the strata in which it occurs and the contamination of fresh water by objectionable water, oil, condensate, gas or other deleterious substance to such fresh water.
13. Any changes to the approved drilling plan and/or these conditions of approval shall be approved by the BLM-CFO Petroleum Engineer prior to being implemented.

Construction:

1. Remove all available topsoil (depths vary from 2 to 4 inches on ridges to 12+ inches in bottoms) from constructed well locations including areas of cut and fill, and temporarily stockpiled at the site. Topsoil will also be salvaged for use in reclamation on all other areas of surface disturbance (roads, pipelines, etc.). Clearly segregate topsoil from excess spoil material. Any topsoil

stockpiled for one year or longer will be signed and stabilized with a suitable species (annual cover crop and native pioneering species, such as slender wheatgrass).

2. The operator will not push soil material and overburden over side slopes or into drainages. All soil material disturbed will be placed in an area where it can be retrieved without creating additional undue surface disturbance and where it does not impede watershed and drainage flows.
3. Construct the backslope no steeper than ½:1, and construct the foreslope no steeper than 2:1, unless otherwise directed by the BLM AO.
4. Maintain a minimum 20-foot undisturbed vegetative border between toe-of-fill of pad and/or pit areas and the edge of adjacent head cuts and steep drainages, unless otherwise directed by the BLM AO.
5. In 2010, APC initiated a Rocky Mountain Avian Protection Plan (RMAPP) to minimize potential hazards for birds in accordance with the Migratory Bird Treaty Act (MBTA), Bald and Golden Eagle Protection Act (BGEPA), and Endangered Species Act (ESA). In 2005, the Avian Power Line Interaction Committee (APLIC) and U.S. Fish and Wildlife Service (USFWS) developed Avian Protection Plan Guidelines. APC developed the RMAPP under the framework of the APLIC and USFWS Guidelines. In accordance with the RMAPP standards, which follow "Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006" (APLIC, 2006), all overhead electrical power lines will be constructed to minimize electrocution potential to birds of prey.
6. Culverts will be placed on channel grade, on firm, uniform beds, which have been shaped to accept them, and aligned parallel to the channel with inlet and outlet rip-rap to minimize erosion. Backfill will be thoroughly compacted.
7. The minimum diameter for culverts will be 18 inches. However, all culverts will be appropriately sized in accordance with standards in BLM Manual 9113.
8. Construction and other project-related traffic will be restricted to approved routes. Cross-country vehicle travel will not be allowed.
9. Maximum design speed on all operator constructed and maintained roads will not exceed 25 miles per hour.
10. Pipeline construction shall not block nor change the natural course of any drainage. Pipelines shall cross perpendicular to drainages. Pipelines shall not be run parallel in drainage bottoms. Suspended pipelines shall provide adequate clearance for maximum runoff.
11. Pipeline trenches shall be compacted during backfilling. Pipeline trenches shall be routinely inspected and maintained to ensure proper settling, stabilization and reclamation.

12. During construction, emissions of particulate matter from well pad and road construction would be minimized by application of water or other non-saline dust suppressants with at least 50 percent control efficiency. Dust inhibitors (surfacing materials, non-saline dust suppressants, and water) will be used as necessary on unpaved roads that present a fugitive dust problem. The use of chemical dust suppressants on public surface will require prior approval from the BLM AO.
13. Operators are required to obtain a National Pollution Discharge Elimination System (NPDES) Storm Water Permit from the WDEQ for any projects that disturb 1 or more acre. This general construction storm water permit must be obtained from WDEQ prior to any surface-disturbing activities.
14. The operator shall submit a Sundry Notice (Form 3160-5) to BLM for approval prior to construction of any new surface-disturbing activities that are not specifically addressed in the approved Application for permit to drill (APD) or Plan of Development (POD) Surface Use Plan of Operations (SUPO).

Operations/Maintenance:

1. Confine all equipment and vehicles to the access road(s), pad(s), and area(s) specified in the approved APD or POD.
2. All waste, other than human waste and drilling fluids, will be contained in a portable trash cage. This waste will be transported to a state-approved waste disposal site immediately upon completion of drilling operations. No trash or empty barrels will be placed in the cuttings collection area or buried on location. All state and local laws and regulations pertaining to disposal of human and solid waste will be complied with.
3. Rat and mouse holes shall be filled and compacted from the bottom to the top immediately upon release of the drilling rig from the location.
4. The operator will be responsible for prevention and control of noxious weeds and weeds of concern on all areas of surface disturbance associated with this project (well locations, roads, water management facilities, etc.). Use of pesticides shall comply with the applicable Federal and state laws. Pesticides shall be used only in accordance with their registered uses and within limitations imposed by the Secretary of Interior on federal lands. Prior to the use of pesticides on public land, the applicator will submit a Wyoming BLM Pesticide Use Proposal for approval prior to using pesticides on BLM surface as well as comply with the required Pesticide Application Record keeping.

5. All permanent above-ground structures (e.g., production equipment, tanks, etc.) not subject to safety requirements will be painted to blend with the natural color of the landscape. The paint used will be determined by the BLM AO.
6. Sewage shall be placed in a self-contained, chemically treated porta-potty on location.
7. The operator and their contractors shall ensure that all use, production, storage, transport, and disposal of hazardous and extremely hazardous materials associated with the drilling, completion and production of this well will be in accordance with all applicable existing or hereafter promulgated federal, state and local government rules, regulations and guidelines. All project-related activities involving hazardous materials will be conducted in a manner to minimize potential environmental impacts. In accordance with Occupational Safety and Health Administration (OSHA) requirements, a file will be maintained onsite containing current Material Safety Data Sheets (MSDS) for all chemicals, compounds and/or substances which are used in the course of construction, drilling, completion and production operations.
8. As closed loop drilling is proposed, produced fluids shall be put in test tanks on location during completion work. Produced water will also be put in tanks during completion work.
9. Because closed loop drilling is proposed a reserve pit is not necessary for planned operations. However, if a reserve pit is used, the only fluids/waste materials which are authorized to go into the reserve pit are Resource, Conservation, and Recovery Act (RCRA) exempt exploration and production wastes. These include:
    - drilling muds & cuttings
    - rigwash
    - excess cement and certain completion & stimulation fluids defined by EPA as exempt

    It does not include drilling rig waste, such as:
    - spent hydraulic fluids
    - used engine oil
    - used oil filter
    - empty cement, drilling mud, or other product sacks
    - empty paint, pipe dope, chemical or other product containers
    - excess chemicals or chemical rinsate

    Any evidence of non-exempt wastes being put into the reserve pit may result in the BLM AO requiring specific testing and closure requirements.
10. Operators are advised that prior to installation of any oil and gas well production equipment which has the potential to emit air contaminants, the owner or operator of the equipment must notify the WDEQ, Air Quality Division to determine permit requirements. Examples of pertinent

well production equipment include fuel-fired equipment (e.g., diesel generators), separators, storage tanks, engines and dehydrators.

Dry Hole/Reclamation:

1. All disturbed lands associated with this project, including the pipelines, access roads, water management facilities, etc., will be expediently reclaimed and reseeded in accordance with the surface use plan and any pertinent site-specific COAs.
2. Disturbed lands will be recontoured back to conform with existing undisturbed topography. No depressions will be left that trap water or form ponds.
3. The fluids and mud must be dry in the cuttings collection area before recontouring in the pit area. The operator will be responsible for recontouring of any subsidence areas that develop from closing a pit before it is completely dry. The plastic pit liner (if any) will be cut off below grade and properly disposed of at a state-authorized landfill before beginning to recontour the site.
4. Before the location has been reshaped and prior to redistributing the topsoil, the operator will rip or scarify the drilling platform and access road on the contour, to a depth of at least 12 inches. The rippers are to be no farther than 24 inches apart.
5. Distribute the topsoil evenly over the entire location and other disturbed areas. Prepare the seedbed by disking following the contour.
6. Waterbars are to be constructed at least one (1) foot deep, on the contour with approximately 2 feet of drop per 100 feet of waterbar to ensure drainage, and extended into established vegetation. All waterbars are to be constructed with the berm on the downhill side to prevent the soft material from silting in the trench. The initial waterbar should be constructed at the top of the backslope. Subsequent waterbars should follow the following general spacing guidelines:

Slope (percent)	Spacing Interval (feet)
Less than 2	200
2 to 4	100
4 to 5	75
Greater than 5	50

7. Seeding will be done on the contour and at the appropriate depth for species (not to exceed 0.5 inch). Certified weed-free seed will be used on all sites unless otherwise specified by surface management agency/owner. Site-specific evaluation will determine the overall seed mixture in conjunction with the BLM or private surface owner.

8. BLM will not release the performance bond until the area has been successfully revegetated (evaluation will be made after the second complete growing season) and has met all other reclamation goals of the surface owner and surface management agency.
9. The operator must submit a Notice of Intent to Abandon and a Subsequent Report of Abandonment for abandonment approval.
10. For performance bond release approval, a Final Abandonment Notice (with a surface owner release letter on split-estate) must be submitted prior to a final abandonment evaluation by BLM.
11. Soil fertility testing and the addition of soil amendments may be required to successfully revegetate some disturbed lands.
12. Any mulch utilized for reclamation and stabilization shall be certified weed-free.

Producing Well:

1. Landscape those areas not required for production to the surrounding topography as soon as possible. The fluids and mud must be dry in the cuttings collection area before recontouring the area. The operator will be responsible for recontouring and reseeding of any subsidence areas.
2. Reduce the backslope to 2:1 and the foreslope to 3:1, unless otherwise directed by the BLM AO. Slopes will be reduced and simulate the prior topography to the extent possible.
3. Production facilities (including dikes) must be placed on the cut portion of the location and a minimum of 15 feet from the toe of the back cut unless otherwise approved by the BLM AO.
4. A dike will be constructed completely around the production facilities (i.e., production tanks, water tanks, and heater-treater). The dikes for the production facilities must be constructed of impermeable soil, hold 110 percent of the capacity of the largest tank plus 1-foot of freeboard, and be independent of the back cut.
5. Any chemicals used in treating the wells (e.g., corrosion inhibitor, emulsion breaker, etc.) will be in a secure, fenced-in area with appropriate secondary containment structure (dikes, catchment pan, etc.).
6. The load out line coming from the oil/condensate tank(s) will have a suitable containment structure to capture and recycle any oil spillage that might occur.
7. Individual production facilities (tanks, treaters, etc.) will be adequately fenced off (if entire facility not already fenced off).
8. Any spilled or leaked oil, produced water or treatment chemicals must be reported in accordance with NTL-3A and immediately cleaned up in accordance with BLM requirements. This includes clean-up and proper disposal of soils contaminated as a result of such spills/leaks.

9. Distribute stockpiled topsoil evenly over those areas not required for production and reseed as recommended.
10. Upgrade and maintain access roads and drainage control (e.g., culverts, drainage dips, ditching, crowning, surfacing, etc.) as necessary and as directed by the BLM AO to prevent soil erosion and accommodate safe, environmentally-sound access.
11. Prior to construction of production facilities not specifically addressed in the APD/POD, the operator shall submit a Sundry Notice to the BLM AO for approval.
12. If not already required prior to constructing and drilling the well location, the operator shall immediately upgrade the entire access road to BLM standards (including topsoiling, crowning, ditching, drainage culverts, surfacing, etc.) to ensure safe, environmentally-sound, year-round access.
13. Waterbars shall be installed on all reclaimed pipeline corridors and installed according to the guidance specified in measure #6 under Dry Hole/Reclamation.

APPENDIX B - INTEGRATED WEED AND PEST MANAGEMENT PLAN

INTEGRATED WEED AND PEST MANAGEMENT PLAN

Mohawk POD
Prepared May 2014 for:

Anadarko
E&P Onshore LLC

Mohawk POD
Converse County, Wyoming

Introduction

This Integrated Pest Management Plan (IPMP) is for Anadarko E&P Onshore LLC and its subsidiaries including Kerr-McGee Oil & Gas Onshore, LP. This project is located in Converse County, Wyoming including:

- Section 12 and 26, Township 33 North, Range 68 West

Noxious weeds are those plants introduced into an area that cause significant economic and/or ecological impact as designated by the State of Wyoming and those species declared noxious by the Converse County Weed and Pest Control District. With the development and associated land disturbance, it is the Company's goal to minimize its impact on the current plant community and to make every effort to put into place this IPMP in order to avoid any noxious weed or weed of concern problems within the project.

Noxious Weed Control

The Company will use an integrated approach to control known noxious weeds or weeds of concern throughout construction, production and reclamation within the project. Weed species, location, landscape and soils will all be taken into consideration when determining the best method of control as well as the surrounding vegetation and land use using a combination of the following methods:

Education:

- The Company will provide periodic weed education and awareness programs for its employees and contractors through the county weed districts, state and federal agencies and educational institutions.
- Employees and contractors will be encouraged to report any new noxious weed infestations to the company representative responsible for weed management.
- Field employees and contractors will be notified of known noxious weeds or weeds of concern in the project area. Measures will be taken to avoid these areas when possible and control methods used in areas of company activity.

Cultural:

- Areas of disturbance will be promptly re-seeded with a certified weed free seed mixture approved by the Bureau of Land Management (BLM), or surface owner.
- Certified weed-free mulch will be used in necessary locations.
- Vehicles and equipment may require cleaning or washing down before leaving or entering areas of known noxious weed infestations.

- Surface disturbance will be minimized to the extent consistent with the Company's right to economically develop its mineral resources.

Physical:

- In newly reseeded areas, mowing will be considered during the first season of establishment, prior to seed formation of weeds of concern.
- Hand pulling of weeds will be considered for small or new infestations.

Biological:

- Domestic animals or Approved biological agents may be used in areas most suited for this type of control, taking into consideration species, desired results, and management needs.
- On BLM surface a Biological Control Agent Release Proposal would be obtained before the release of any biological control agents.

Chemical:

- The use of herbicides to control noxious weeds has been found to be very effective and feasible. Herbicides used will be specific for target species, location and follow label instructions in order to obtain desired control for identified species.
- Application of herbicides will be done by a commercially licensed applicator.
- On BLM administered public lands, an approved Pesticide Use Permit (PUP) will be obtained from the local BLM office. Only herbicides approved for application on BLM administered lands will be used.
- Control/treatment of noxious weeds/weeds of concern on private surface will be done in accordance with the existing Surface Use Agreement.

Target Species Management

Scotch Thistle (*Onopordum acanthium L.*): Biennial that grows up to 12 feet tall that reproduces by seed only. Rosette formed the first year, and flowering stem elongates the second year. Leaves are large coarsely lobed, hairy on both sides, velvety gray appearance. Margins are lined with sharp conspicuous spines. Basal leaves can grow to 2 feet long and 1 foot wide. Flowers are violet to reddish.

Management Objective: Containment.
Integrated treatment:

Cultural: Plant competition is an effective way to prevent the invasion of musk thistle. Proper management of perennial grasses will inhibit the establishment of this weed.

Physical/Mechanical: Mowing will not kill the plant but will lessen the seed production if it keeps the seed heads from maturing. Small areas can be eradicated by cutting the plant off below the soil surface.

Biological: No biological controls are available at this time.

Chemical: Because of their shorter life cycle, scotch thistle can be effectively controlled by herbicides. 2,4-D and picloram are both effective control agents.

Canada Thistle (*Cirsium arvense L.*): A colony forming perennial that reproduces from seed and creeping rootstalks and can grow up to 4 feet tall. Leaves vary from light to dark green, oblong or lance shaped with deeply grooved spiny toothed margins. Flowers form in small bristly clusters that are light lavender to deep rose purple.

Management Objective: Containment.
Integrated treatment:

Cultural: Plant competition is an effective way to prevent the invasion of Canada thistle. Proper management of perennial grasses will inhibit the establishment of this weed

Physical/Mechanical: Hand pulling is not effective. Cultivation will reduce density if done repeatedly every three to four weeks.

Biological: Canada thistle stem weevil; Canada thistle bud weevil; Thistle stem gall fly.

Chemical: 2,4-D, Picloram, Dicamba and Curtail are all effective control agents.

Buffalo Bur (*Solanum rostratum*): Taprooted annual also known as Kansas thistle and prickly nightshade. Bears long, yellow spines on stems, leaves, and flower heads and can grow to a height of 2 feet. It is common in sandy, exposed soil and is highly drought-resistant. Bright yellow flowers are evident in summer and spines cover the calyx; it enlarges and forms a spiny bur, enclosing and completely covering the seedpod.

Management Objective: Containment
Integrated Treatment:

Cultural: Good competitive vegetative cover helps

Physical/Mechanical: Repeated close mowing and hand pulling when the soil is moist is effective.

Biological: None identified.

Chemical: Dicamba, Triclopyr, and 2,4-D are effective control agents.

Spotted knapweed (*Centaurea maculosa* Lam.) Biennial or short lived perennial, up to 3 ft. tall. Rosette formed first year, flowering stalk elongates second year. Leaves are long and divided below, short and narrow above and covered with fine hair. Seed heads mostly on branch tips, solitary, to 1" diameter. Pink to purple, rarely white. Seed head bracts are black tipped, with 5 to 7 pairs of short feathery appendages. Seeds are brownish, 1/8 " long, notched on one side of base, short tuft of bristles at tip end. Very aggressive, can infest large areas quickly, offers very little big game or livestock forage value.

Management Objective: Containment
Integrated Treatment

Cultural: Carefully managed, repeated grazing by sheep and goats early in the spring when grasses are dormant reduces spotted knapweed seedling and rosettes.

Physical/Mechanical: Repeated plowing or tillage treatment will reduce density, burning or mowing is not effective

Biological: No biological controls are available at this time.

Chemical: Picoloram with 2,4-D or Curtail are effective control agents.

Field bindweed (*Convolvulus arvensis L.*): Perennial vine, reproducing form seed and roots. Leaves are alternate, simple, arrow shaped, rounded or blunt tipped. Stem is prostrate, twining mat forming up to 10 ft long. Flowers are pale pink to white funnel shaped, two small-like bracts attached below flower on flower stem. Roots are extensive creeping rhizomes. Seeds are four per capsule, dark gray to reddish brown, three sided, Seeds viable over 60 years.

Management Objective: Prevention/Containment
Integrated Treatment:

Cultural: Sheep have been used to control field bindweed, but they will only eat the above ground parts of the plant when desirable vegetation is not available.

Physical/Mechanical: Hand pulling field bindweed can be effective when the plant is in the seedling or young adult stage. Hand pulling mature plants is not as effective because root and rhizome fragments that are left behind will re-sprout into new plants.

Biological: *Tyta luctuosa*, or European moth, will defoliate field bindweed as a caterpillar. *Chelymorpha cassidea*, a tortoise beetle, feeds on the leaves of the plant and is native to the United States. Biological control of field bindweed has had little success at this time.

Chemical: Herbicides such as dicamba, glyphosate, dicamba, 2,4 D mixtures and spot-spray 2,4 D have been somewhat effective for suppression, but may not be effective for eradication.

Puncture Vine (*Tribulus terrestris* L.): Annual, mat forming with trailing stems. Leaves are opposite, hairy, divided into 4 to 8 pairs of leaflets. Flowers are yellow, with 5 petals, borne in the lead axils. Fruits consist of 5 sections with at maturity break into tack-like structures with sharp spines. Sometimes curving spines, each section 2 to 4 seeded. The seed will remain dormant in the soil for 4 to 5 years, which makes eradication difficult.
Management Objective: Containment
Integrated Treatment

Cultural: After mechanical or chemical control establish desirable vegetation to occupy the vacant space and to complete with new puncture vine seedlings.

Physical/Mechanical: As with annuals mechanical controls are effective, hand-pulling, hoeing, and shallow cultivation. Because of puncture vine's low growing form makes mowing ineffective.

Biological: The puncture vine seed weevil (*Microlarinus lareynni*) feeds upon developing seeds. The second weevil, the puncture vine stem weevil (*Microlarimus lypriformis*) mines the stems and roots of the weed.

Chemical: 2,4-D or dicamba are effective control agents.

Musk Thistle (*Carduus nutans* L.): Biennial, or winter annual, which grows up to 7' tall. Leaves are dark green with light green midrib, deeply lobed and spiny margined. Leaves extend onto the stem giving them a winged appearance. Flower heads are terminal, solitary, and usually bent over. Flowers are deep rose, violet, or purple, occasionally white. Fruits are shiny, yellowish-brown with a plum of white hair-like fibers. It spreads rapidly forming extremely dense stands which crowd out desirable forages.

Management Objective: Containment
Integrated Treatment

Cultural: Do not overgraze and fertilize only when necessary and according to soil testing recommendations. To successfully manage musk thistle, prevent seed formation.

Physical/Mechanical: Musk thistle will not tolerate tillage and can be removed easily by severing its roots below grown with a shovel or hoe. Mowing can effectively reduce seed output if plants are cut when the terminal head is in the late-flowering stage. Gather and burn mowed debris to destroy any seed that has developed.

Biological: *Trichosirocalus horridus* is a weevil that attacks the crown area of mush thistle rosettes and kills or weakens the plant before it bolts. The musk thistle seed head weevil, *Rhinocyllus conicus*, that deposits eggs on back of developing flowers, after hatching larvae bore into the flower and destroy developing seed.

Chemical: Tordon 22K, Milestone, 2,4-D or dicamba are effective control agents.

Mosquito Control

Wyoming along with many other western states has seen the introduction of West Nile Virus. The most common way for the spread of this virus is through mosquito bites. The Company will work closely with the Converse County Weed & Pest Board to address areas that may be potential breeding sites for mosquitoes and use recommended and approved products to control mosquito populations. The company will continue to communicate with the weed and pest board in order to stay current on new mosquito treatment techniques and ways to reduce breeding sites.

Scotch thistle

Canada thistle

Buffalo Burr

Spotted Knapweed

Field Bindweed

Puncture Vine

Musk Thistle

References

Bureau of Land Management, Wyoming. Invasive Plants. Online information from http://www.blm.gov/wy/st/en/programs/Invasive_Plants.1.html April 2007.

Coal Bed Natural Gas Well Application for Permit to Drill and Plan of Development Preparation Guide. Buffalo Field Office, Bureau of Land Management, Wyoming. August 11, 2003.

Sheryl Schwartzkopf, Converse County Weed and Pest Control District, (Personal Communication), September, 2012.

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INTEGRATED WEED AND PEST MANAGEMENT PLAN

SHAWNEE CHILLICOTHE
Prepared September 2012 for:

Prepared for:
Kerr-McGee Oil & Gas Onshore, LP

Shawnee Chillicothe
Converse County, Wyoming

Introduction

This Integrated Pest Management Plan (IPMP) is for Kerr-McGee Oil & Gas Onshore, LP a subsidiary of Anadarko Petroleum Corporation (the Company) proposed well locations. This project is located in Converse County, Wyoming including:

- Section 2 , Township 32 North, Range 69 West
- Section 32, Township 33 North, Range 68 West
- Section 8, Township 32 North, Range 68 West

Noxious weeds are those plants introduced into an area that cause significant economic and/or ecological impact as designated by the State of Wyoming and those species declared noxious by the Converse County Weed and Pest Control District. With the development and associated land disturbance, it is the Company's goal to minimize its impact on the current plant community and to make every effort to put into place this IPMP in order to avoid any noxious weed or weed of concern problems within the project.

Noxious Weed Control

The Company will use an integrated approach to control known noxious weeds or weeds of concern throughout construction, production and reclamation within the project. Weed species, location, landscape and soils will all be taken into consideration when determining the best method of control as well as the surrounding vegetation and land use using a combination of the following methods:

Education:

- The Company will provide periodic weed education and awareness programs for its employees and contractors through the county weed districts, state and federal agencies and educational institutions.
- Employees and contractors will be encouraged to report any new noxious weed infestations to the company representative responsible for weed management.
- Field employees and contractors will be notified of known noxious weeds or weeds of concern in the project area. Measures will be taken to avoid these areas when possible and control methods used in areas of company activity.

Cultural:

- Areas of disturbance will be promptly re-seeded with a certified weed free seed mixture approved by the Bureau of Land Management (BLM), or surface owner.
- Certified weed-free mulch will be used in necessary locations.
- Vehicles and equipment may require cleaning or washing down before leaving or entering areas of known noxious weed infestations.
- Surface disturbance will be minimized to the extent consistent with the Company's right to economically develop its mineral resources.

Physical:

- In newly reseeded areas, mowing will be considered during the first season of establishment, prior to seed formation of weeds of concern.
- Hand pulling of weeds will be considered for small or new infestations.

Biological:

- Domestic animals or Approved biological agents may be used in areas most suited for this type of control, taking into consideration species, desired results, and management needs.
- On BLM surface a Biological Control Agent Release Proposal would be obtained before the release of any biological control agents.

Chemical:

- The use of herbicides to control noxious weeds has been found to be very effective and feasible. Herbicides used will be specific for target species, location and follow label instructions in order to obtain desired control for identified species.
- Application of herbicides will be done by a commercially licensed applicator.
- On BLM administered public lands, an approved Pesticide Use Permit (PUP) will be obtained from the local BLM office. Only herbicides approved for application on BLM administered lands will be used.
- Control/treatment of noxious weeds/weeds of concern on private surface will be done in accordance with the existing Surface Use Agreement.

Target Species Management

Scotch Thistle (*Onopordum acanthium L.*): Biennial that grows up to 12 feet tall that reproduces by seed only. Rosette formed the first year, and flowering stem elongates the second year. Leaves are large coarsely lobed, hairy on both sides, velvety gray appearance. Margins are lined with sharp conspicuous spines. Basal leaves can grow to 2 feet long and 1 foot wide. Flowers are violet to reddish.

Management Objective: Containment.
Integrated treatment:

Cultural: Plant competition is an effective way to prevent the invasion of musk thistle. Proper management of perennial grasses will inhibit the establishment of this weed.

Physical/Mechanical: Mowing will not kill the plant but will lessen the seed production if it keeps the seed heads from maturing. Small areas can be eradicated by cutting the plant off below the soil surface.

Biological: No biological controls are available at this time.

Chemical: Because of their shorter life cycle, scotch thistle can be effectively controlled by herbicides. 2,4-D and picloram are both effective control agents.

Canada Thistle (*Cirsium arvense L.*): A colony forming perennial that reproduces from seed and creeping rootstalks and can grow up to 4 feet tall. Leaves vary from light to dark green, oblong or lance shaped with deeply grooved spiny toothed margins. Flowers form in small bristly clusters that are light lavender to deep rose purple.

Management Objective: Containment.
Integrated treatment:

- Cultural: Plant competition is an effective way to prevent the invasion of Canada thistle. Proper management of perennial grasses will inhibit the establishment of this weed
- Physical/Mechanical: Hand pulling is not effective. Cultivation will reduce density if done repeatedly every three to four weeks.
- Biological: Canada thistle stem weevil; Canada thistle bud weevil; Thistle stem gall fly.
- Chemical: 2,4-D, Picloram, Dicamba and Curtail are all effective control agents.

Buffalo Bur (*Solanum rostratum*): Taprooted annual also known as Kansas thistle and prickly nightshade. Bears long, yellow spines on stems, leaves, and flower heads and can grow to a height of 2 feet. It is common in sandy, exposed soil and is highly drought-resistant. Bright yellow flowers are evident in summer and spines cover the calyx; it enlarges and forms a spiny bur, enclosing and completely covering the seedpod.

Management Objective: Containment
Integrated Treatment:

- Cultural: Good competitive vegetative cover helps
- Physical/Mechanical: Repeated close mowing and hand pulling when the soil is moist is effective.
- Biological: None identified.
- Chemical: Dicamba, Triclopyr, and 2,4-D are effective control agents.

Spotted knapweed (*Centaurea maculosa* Lam.) Biennial or short lived perennial, up to 3 ft. tall. Rosette formed first year, flowering stalk elongates second year. Leaves are long and divided below, short and narrow above and covered with fine hair. Seed heads mostly on branch tips, solitary, to 1" diameter. Pink to purple, rarely white. Seed head bracts are black tipped, with 5 to 7 pairs of short feathery appendages. Seeds are brownish, 1/8 " long, notched on one side of base, short tuft of bristles at tip end. Very aggressive, can infest large areas quickly, offers very little big game or livestock forage value.

Management Objective: Containment
Integrated Treatment

- Cultural: Carefully managed, repeated grazing by sheep and goats early in the spring when grasses are dormant reduces spotted knapweed seedling and rosettes.
- Physical/Mechanical: Repeated plowing or tillage treatment will reduce density, burning or mowing is not effective
- Biological: No biological controls are available at this time.
- Chemical: Picoloram with 2,4-D or Curtail are effective control agents.

Field bindweed (*Convolvulus arvensis L.*): Perennial vine, reproducing form seed and roots. Leaves are alternate, simple, arrow shaped, rounded or blunt tipped. Stem is prostrate, twining mat forming up to 10 ft long. Flowers are pale pink to white funnel shaped, two small-like bracts attached below flower on flower stem. Roots are extensive creeping rhizomes. Seeds are four per capsule, dark gray to reddish brown, three sided, Seeds viable over 60 years.

Management Objective: Prevention/Containment
Integrated Treatment:

Cultural: Sheep have been used to control field bindweed, but they will only eat the above ground parts of the plant when desirable vegetation is not available.

Physical/Mechanical: Hand pulling field bindweed can be effective when the plant is in the seedling or young adult stage. Hand pulling mature plants is not as effective because root and rhizome fragments that are left behind will re-sprout into new plants.

Biological: *Tyta luctuosa*, or European moth, will defoliate field bindweed as a caterpillar. *Chelymorpha cassidea*, a tortoise beetle, feeds on the leaves of the plant and is native to the United States. Biological control of field bindweed has had little success at this time.

Chemical: Herbicides such as dicamba, glyphosate, dicamba, 2,4 D mixtures and spot-spray 2,4 D have been somewhat effective for suppression, but may not be effective for eradication.

Puncture Vine (*Tribulus terrestris* L.): Annual, mat forming with trailing stems. Leaves are opposite, hairy, divided into 4 to 8 pairs of leaflets. Flowers are yellow, with 5 petals, borne in the lead axils. Fruits consist of 5 sections with at maturity break into tack-like structures with sharp spines. Sometimes curving spines, each section 2 to 4 seeded. The seed will remain dormant in the soil for 4 to 5 years, which makes eradication difficult.
Management Objective: Containment
Integrated Treatment

Cultural: After mechanical or chemical control establish desirable vegetation to occupy the vacant space and to complete with new puncture vine seedlings.

Physical/Mechanical: As with annuals mechanical controls are effective, hand-pulling, hoeing, and shallow cultivation. Because of puncture vine's low growing form makes mowing ineffective.

Biological: The puncture vine seed weevil (*Microlarinus lareynni*) feeds upon developing seeds. The second weevil, the puncture vine stem weevil (*Microlarimus lypriformis*) mines the stems and roots of the weed.

Chemical: 2,4-D or dicamba are effective control agents.

Musk Thistle (*Carduus nutans* L.): Biennial, or winter annual, which grows up to 7' tall. Leaves are dark green with light green midrib, deeply lobed and spiny margined. Leaves extend onto the stem giving them a winged appearance. Flower heads are terminal, solitary, and usually bent over. Flowers are deep rose, violet, or purple, occasionally white. Fruits are shiny, yellowish-brown with a plum of white hair-like fibers. It spreads rapidly forming extremely dense stands which crowd out desirable forages.

Management Objective: Containment
Integrated Treatment

Cultural: Do not overgraze and fertilize only when necessary and according to soil testing recommendations. To successfully manage musk thistle, prevent seed formation.

Physical/Mechanical: Musk thistle will not tolerate tillage and can be removed easily by severing its roots below grown with a shovel or hoe. Mowing can effectively reduce seed output if plants are cut when the terminal head is in the late-flowering stage. Gather and burn mowed debris to destroy any seed that has developed.

Biological: *Trichosirocalus horridus* is a weevil that attacks the crown area of mush thistle rosettes and kills or weakens the plant before it bolts. The musk thistle seed head weevil, *Rhinocyllus conicus*, that deposits eggs on back of developing flowers, after hatching larvae bore into the flower and destroy developing seed.

Chemical: Tordon 22K, Milestone, 2,4-D or dicamba are effective control agents.

Mosquito Control

Wyoming along with many other western states has seen the introduction of West Nile Virus. The most common way for the spread of this virus is through mosquito bites. The Company is aware that their development could include water impoundments that may contribute to mosquito reproduction. The Company will work closely with the Converse County Weed & Pest Board to address areas that may be potential breeding sites for mosquitoes and use recommended and approved products to control mosquito populations. The company will continue to communicate with the weed and pest board in order to stay current on new mosquito treatment techniques and ways to reduce breeding sites.

Scotch thistle

Canada thistle

Buffalo Burr

Spotted Knapweed

Field Bindweed

Puncture Vine

Musk Thistle

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