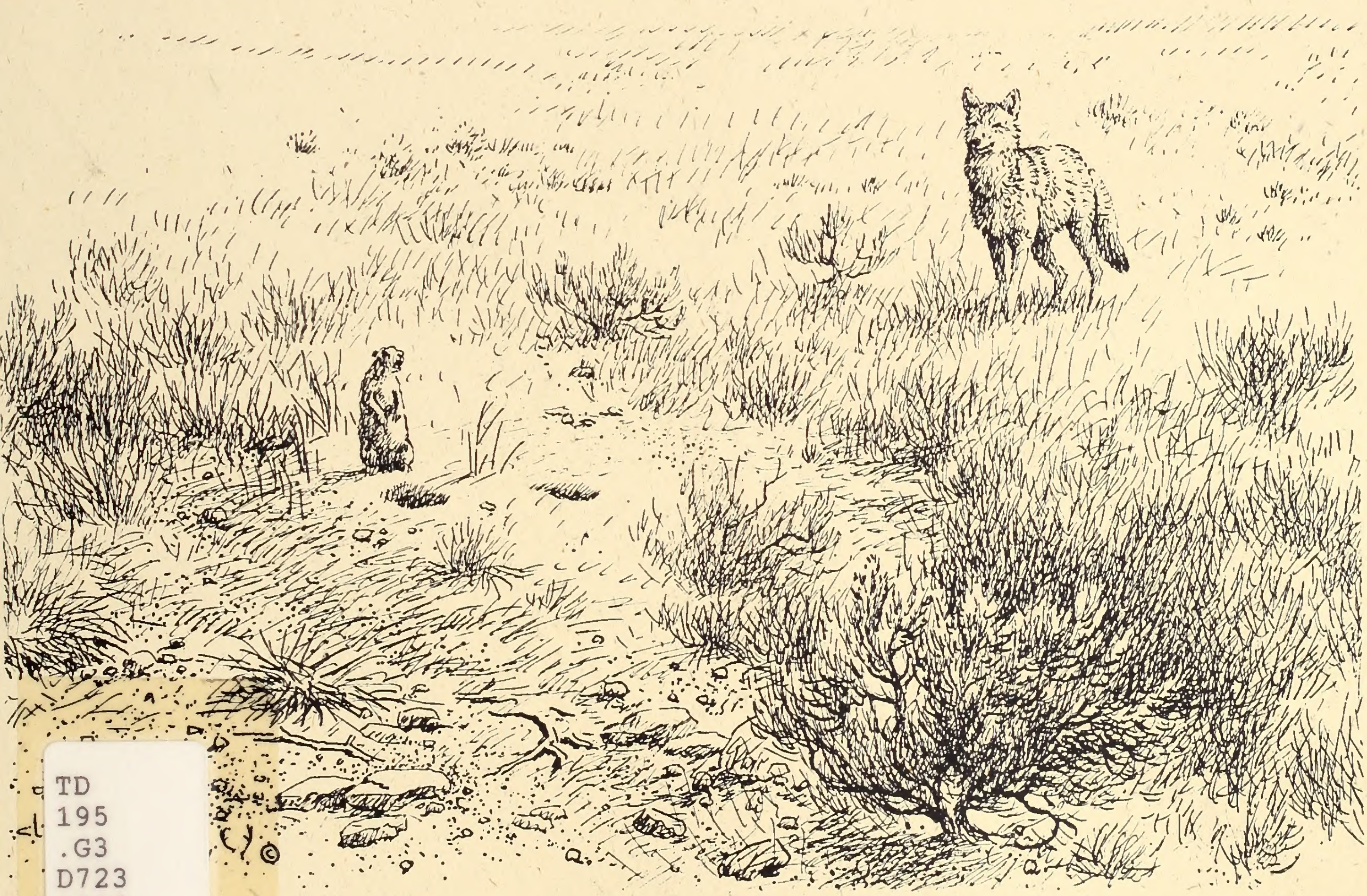
U.S. Department of the Interior
Bureau of Land Management
Wyoming State Office

Rawlins District Office/Great Divide Resource Area January 1995

DRAFT
Environmental Impact Statement
Union Pacific Resources Company Greater Wamsutter Area II Natural Gas Development Project



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United States Department of the Interior

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January 12, 1995

Dear Reader:

This draft Environmental Impact Statement (EIS) is prepared pursuant to 40 CFR 1500-1508, for the Greater Wamsutter Area II Natural Gas Development Project in Carbon and Sweetwater Counties, Wyoming. The EIS is provided for your review and comment and the Final Environmental Impact Statement (FEIS) will be based on comments received on this draft. Please keep this copy of the EIS for future use in your review of the final EIS.

The public comment period for this EIS will close 60 days after the Environmental Protection Agency publishes their Notice of Availability of the EIS in the *Federal Register*. When making written comments, please be as specific as possible and identify the chapter, page, and paragraph to which the comments pertain. The purpose of the review and comment period is to provide you an opportunity to participate in the environmental analysis process and the ultimate decisions reached.

A public meeting is currently scheduled for the Greater Wamsutter Area II Natural Gas Development Project EIS at the Great Divide Resource Area Office, 812 E. Murray, Rawlins, Wyoming, on Thursday, February 23, 1995, at 7:00 p.m. Should a change in scheduling occur, you will be notified.

Please address comments on this EIS or requests for additional copies of the EIS to:

John Spehar
Bureau of Land Management
Rawlins District Office
P.O. Box 670
Rawlins, Wyoming 82301

Sincerely,

Gordon Schuh
for
Robert A. Bennett
Acting State Director

DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR THE GREATER WAMSUTTER AREA II NATURAL GAS DEVELOPMENT CARBON AND SWEETWATER COUNTIES, WYOMING

(X) Draft ( ) Final

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

Abstract:

This draft Environmental Impact Statement assesses the environmental consequences of a proposed natural gas development project in southwestern Carbon and eastern Sweetwater Counties, approximately 45 miles southwest of Rawlins, Wyoming. Public scoping commenced on December 13, 1993. All issues raised during scoping and interdisciplinary team preparation of the analysis are addressed. The proposed project details the drilling, completion, testing, operation, abandonment, and reclamation of a natural gas production operation by Union Pacific Resources Company, Amoco Production Company, and other operators. The proposed project would use standard procedures as currently employed by other State and regional gas field developments. A maximum of 750 wells at 300 locations and associated ancillary facilities, road, and pipelines would result in the initial disturbance of approximately 2,416 acres on the project area. Numerous standard, project-specific, and site-specific mitigation measures would be employed to assure that project impacts are minimized on all important resources. Impacts to most resources would be negligible to moderate during the life-of-project. Potentially significant impacts resulting from the project include the changes to visual resources. The proposed project could also have numerous beneficial impacts including increased revenues generated by taxes, royalties, and the use of local goods and services.

EIS Contact:

Comments on this EIS should be directed to:

Mr. John Spehar
Rawlins District Office
Bureau of Land Management
P.O. Box 670
Rawlins, Wyoming 82301

For further information, contact John Spehar at the Rawlins District Office phone 307-324-7171.

Date draft EIS Made Available to EPA and the Public: January 23, 1995

Date comments on the draft EIS must be received to be considered in the Final EIS: March 25, 1995

DRAFT
ENVIRONMENTAL IMPACT STATEMENT

GREATER WAMSUTTER AREA II
NATURAL GAS DEVELOPMENT PROJECT

Prepared by

U.S. Department of the Interior
Bureau of Land Management
Great Divide Resource Area
Rawlins, Wyoming

and

Gary Holsan Environmental Planning
Thayne, Wyoming

January 1995

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ABBREVIATIONS/ACRONYMS

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ac-ft	acre feet
Amoco	Amoco Production Company
AO	authorized officer
ANC	acid neutralizing capacity
APD	Application for Permit to Drill
APE	area of potential effect
AQRV	air quality-related values
AUM	animal unit month
Barrett	Barrett Resources Company
bbls	barrels
bcf	billion cubic feet
BCPD	barrels of condensate per day
B.P.	before present
BLM	U.S. Department of the Interior Bureau of Land Management
BO	barrels of oil
BOE	barrels of oil equivalent
BOD	biochemical oxygen demand
BOP	blowout preventer
BWPD	barrel weight per day
CBGA	Creston Blue Gap Area
cc	cubic centimeters
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second
CIA	cumulative impacts area
CIG	Colorado Interstate Gas Company
Cl	chloride
CMP	corrugated metal pipe
CO	carbon monoxide
CO_2	carbon dioxide
COE	U.S. Army Corps of Engineers
cu.ft/day	cubic feet per day
CWA	Clean Water Act
dBA	decibel
DEQ	Department of Environmental Quality
EA	environmental assessment
EIS	environmental impact statement
EMT	emergency medical technician
EPA	Environmental Protection Agency
ESA	Endangered Species Act
°F	degrees Fahrenheit
FAA	Federal Aviation Administration
FEMA	Federal Emergency Management Act
FHWA	Federal Highway Administration

ABBREVIATIONS (Continued)

FS	U.S. Department of Agriculture Forest Service
FWS	U.S. Department of the Interior Fish and Wildlife Service
FY	fiscal year
GIS	geographic information system
gpm	gallons per minute
GWA II	Greater Wamsutter II Analysis Area
GWA EA	Greater Wamsutter Area Environmental Assessment
H_2S	hydrogen sulfide
HWA	Hayden-Wing Associates
I-80	Interstate Highway 80
IDT	Interdisciplinary team
KB	Kelly bushing
KOP	kick-off point
µg/l	micrograms per liter
mg/l	milligrams per liter
MBC	thousand barrels of condensate
MBO	thousand barrels of oil
MCFG	thousand cubic feet of gas at one atmosphere pressure
MMBO	million barrels of oil
MMCF	million cubic feet
MMCFG	million cubic feet of gas at one atmosphere pressure
MMCFD	million cubic feet per day
mph	miles per hour
MSDS	Material Safety Data Sheet
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act of 1969
NPC	Northwest Pipeline Company
NPDES	National Pollution Discharge Elimination System
NO_2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NRHP	National Register of Historic Places
NSO	no surface occupancy
NTU	Nephelometric Turbidity Unit
NWI	National Wetlands Inventory
NWR	National Wildlife Refuge
OHV	off-highway vehicle
OSHA	Occupational Safety and Health Administration
PG&E	Pacific Gas and Electric Company
PI	Petroleum Information, Inc.
PLS	pure live seed
PM_{10}	particulate matter less than 10 microns in size
POD	plan of development
ppg	parts per gallon
PPP	Pollution Prevention Plan

ABBREVIATIONS (Continued)

PSD	Prevention of Significant Deterioration
RCRA	Resource Conservation and Recovery Act
RMOGA	Rocky Mountain Oil & Gas Association
RMP	resource management plan
ROD	record of decision
ROS	Recreation Opportunity Spectrum
ROW	right-of-way
SARA	Superfund Amendments and Reauthorization Act
sec/qt.	seconds per quart
SCRAM	Support Center for Regulatory Air Models
SEO	State Engineer's Office
SHPO	State Historic Preservation Office (or officer)
SMA	surface management agency
SPCC	Spill Prevention and Control Countermeasure
SO_2	sulfur dioxide
SWPPP	Storm Water Pollution Prevention Plan
t/ac	tons per acre
t/ac/yr	tons per acre per year
t/yr	tons per year
TD	total depth
TDS	total dissolved solids
TPQ	threshold planning quality
TSP	total suspended particulates
TVD	true vertical depth
UCG	Underground Coal Gassification
UPRC	Union Pacific Resources Company
USDA	United States Department of Agriculture
USDI	United States Department of the Interior
USGS	U.S. Geological Survey
USLE	universal soil loss equation
VQO	Visual Quality Objectives
VRM	Visual Resource Management
WAAQS	Wyoming Ambient Air Quality Standards
WAQSR	Wyoming Air Quality Standard Regulations
WDEQ	Wyoming Department of Environmental Quality
WGFD	Wyoming Game and Fish Department
WOGCC	Wyoming Oil and Gas Conservation Committee
WOS	Wildlife Observation System
WP	working pressure
WYNDD	Wyoming Natural Diversity Database

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EXECUTIVE SUMMARY

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S.0 INTRODUCTION

This Draft Environmental Impact Statement (DEIS) analyzes the impacts of drilling and production operations in the Greater Wamsutter Area II (GWA II) natural gas-producing area of southern Wyoming. The GWA II analysis area is located in southeastern Sweetwater County and southwestern Carbon County, Wyoming, within Townships 16 through 22 North (T16-22N), Ranges 92 through 95 West (R92-95W), 6th Principal Meridian. The analysis area encompasses 334,191 acres of mixed federal, state, and private lands. Of this total, approximately 146,912 acres are federal, 19,240 acres are State of Wyoming lands, and 168,039 are private lands.

This DEIS has been prepared pursuant to the National Environmental Policy Act. Chapter 1 defines the Purpose and Need for the proposed project. Chapter 2 details the parameters of the Proposed Action and other alternatives as well as a summary of proposed mitigation and monitoring measures to avoid or reduce impacts proposed by Union Pacific Resources Corporation (UPRC) and other GWA II operators (the Operators). Chapter 3 discusses the areas and resources that would be affected under each alternative. Chapter 4 examines the environmental consequences to each resource under each alternative and also provides a summary of additional mitigation measures by resource discipline which were identified during the analysis process. The measures and requirements describe how implementation of the Proposed Action or alternatives should be managed to assure minimal impacts in the GWA II analysis area and adjacent lands. It is anticipated that all impacts that would occur with implementation of the proposed project could be effectively and feasibly mitigated with the measures presented in the mitigation summaries of Chapters 2 and 4. Chapter 5 summarizes the consultation and coordination accomplished with various federal, state, county, and local agencies, elected representatives, environmental and citizen groups, industries, and individuals potentially concerned with issues regarding the proposed drilling action.

This DEIS addresses a maximum development scenario proposed by the GWA II operators (Proposed Action) and three other alternatives.

The Proposed Action would increase drilling production in the GWA II analysis area by allowing the Operators to develop 750 wells and 300 well locations within the analysis area in addition to existing operations. The other three alternatives analyzed in this DEIS are: 1) Alternative A, which would allow the Operators to develop 300 wells and 250 well locations within the analysis area in addition to existing operations; 2) Alternative B, which would allow the Operators to develop 225 wells and 200 locations within the analysis area in addition to existing operations; and 3) Alternative C, the No Action alternative, which would disallow any further gas/oil development beyond that currently authorized.

In the Final Environmental Impact Statement (FEIS), the Bureau of Land Management (BLM) Rawlins District will identify a preferred alternative based on the analysis of the DEIS and public comment on the alternatives and their associated impacts.

The GWA II natural gas production project EIS was prepared by a third party contractor working under the direction of, and in cooperation with the lead agency for the project, which is the Bureau of Land Management (BLM) Great Divide Resource Area, and Rawlins District Office, Rawlins, Wyoming.

S.0.1 Background

Management of federal lands within the GWA II analysis area is provided by the Record of Decision and Approved Resource Management Plan for the Great Divide Resource Area (USDI-BLM 1990a. The proposed natural gas production project and alternatives are in conformance with management objectives provided in the Great Divide Resource Area RMP.

Lands associated with the additional drilling program include those previously analyzed in the GWA Natural Gas Project Environmental Assessment (EA) (USDI-BLM 1992a, and additional mixed federal and private lands located north of Interstate 80. The additional area combines with the previously analyzed area to form the Greater Wamsutter Area II (GWA II) analysis area. Currently, natural gas drilling and development activities within the GWA are authorized by the approved GWA EA.

The Decision Record and Finding of No Significant Impact (USDI-BLM 1992a) for the GWA Natural Gas Project provided for permitting a maximum development pattern of 70 new production gas wells within the GWA and associated access roads, pipelines, and other ancillary facilities. Since completion of the EA, 70 wells have been drilled by Union Pacific Resources Company (UPRC) and other operators, with current plans calling for additional production well drilling and development within the GWA II analysis area.

UPRC, Amoco Production Company, (Amoco), and other GWA II operators have proposed to drill and develop 300 additional well locations (750 wells) in addition to the existing drilling and production operations within the GWA II analysis area. This proposal would provide for full development of the natural gas fields within the GWA II analysis area. The precise number of wells, locations of wells, and timing of drilling would be directed by the success of developing drilling and production technology, as well as economic considerations such as drilling and production costs.

The BLM has advised UPRC and the other GWA II operators that an environmental impact statement (EIS) of the GWA II analysis area would be initiated in view of UPRC and other operators' plans to drill additional infill locations and construct ancillary facilities within the GWA II analysis area in 1994 and beyond at levels not previously analyzed in the GWA EA.

S.1 PROPOSED ACTION AND ALTERNATIVES

S.1.1 Proposed Action

The Proposed Action provides a maximum development scenario of 750 wells and 300 locations within the GWA II analysis area, in addition to existing operations. Under the Proposed Action, once the development drilling program by UPRC is finalized, 225 of the proposed 750 wells with known gas reserves would initially be drilled. This proposed action allows for the continued development of proven natural gas reserves and provides the Operators the opportunity to explore new drilling and production techniques necessary for the development of marginal properties. The remaining wells described in the Proposed Action would be developed over some unspecified time period from late 1996 and several years beyond. The precise number of wells, locations of wells, and timing of drilling would be directed by the success of developing effective drilling and production technologies, and economic considerations. The development scenario would affect 2,416 acres, bringing the total disturbance within the GWA II analysis area to 14,943 acres of land (4.5 percent of the total GWA II surface area). This development scenario would involve clearing land and constructing well sites, access roads, pipelines, and associated facilities.

S.1.2 Alternative A

Alternative A provides an optimal development scenario of 300 wells and 250 well locations within the GWA II analysis area, in addition to existing operations. Should the planned experimental drilling and production techniques prove to be moderately successful, then some, but not all, marginal properties within the analysis area would be developed. The minimum 225 wells and 200 locations would be developed during 1994 through 1996, and the remaining 75 wells (at 50 well locations) would be developed from 1996 and beyond. Alternative A would affect 2,015 acres, bringing the total disturbance within the GWA II analysis area to 14,542 acres (4.4 percent of the overall GWA II surface area). This development scenario would involve clearing land and constructing well sites, access roads, pipelines, and associated facilities.

S.1.3 Alternative B

Alternative B provides a minimum development scenario of 225 wells and 200 locations, in addition to existing operations. Should the planned experimental drilling and production techniques prove not to be economically viable, then the minimum 225 wells (at 200 locations) would be developed during 1994 through 1996. Additional drilling as described in the Proposed Action would not be completed by the Operators. Alternative B would affect 1,613 acres, bringing the total disturbance within the GWA II analysis area to 14,140 acres of land (4.2 percent of the total GWA II surface area). This development scenario would involve clearing land and constructing well sites, access roads, pipelines, and associated facilities.

S.1.4 Alternative C

Alternative C, the No Action Alternative, implies that on-going natural gas production activities would be allowed to continue by the BLM in the GWA II analysis area, but the proposed full field development program and the other development alternatives would be disallowed. Additional Applications to Drill (APDs) and right-of-way (ROW) actions would be granted by the BLM on a case-by-case basis.

S.1.5 Major Impact Conclusions

The GWA II natural gas development proposal could cause direct and indirect, short-term and long-term, as well as cumulative disturbance of the human and natural environments. Potential environmental impacts that could result from implementation of the Proposed Action and/or the alternatives are detailed in Chapter 4 of this EIS. A summary of proposed mitigation and monitoring measures to avoid or reduce impacts as committed to by the GWA II operators are presented in Chapter 2. Chapter 4 summarizes the environmental impacts for each resource discipline which were identified during the analysis process and which follow below.

S.2 RESOURCE ELEMENTS ANALYZED

S.2.1 Geology/Paleontology

Implementation of the Proposed Action and Alternatives A, B, and C would result in construction excavation associated with the development of well pads, access roads, pipelines and other production facilities which could directly result in the exposure and damage or destruction of scientifically significant fossil resources. The potential magnitude of impact to fossil resources associated with the action alternatives (the Proposed Action, Alternatives A and B) varies proportionally with the total number of wells which would be developed under each alternative. The magnitude of impact for Alternative C - No Action, which would allow additional APDs and ROW action on a case-by-case basis, is unknown at present and would depend on the specific action taken and the specific area involved. Potential for impacts to project facilities as a result of seismic activity is low, as is the potential for landslides and road subsidence that would temporarily close access roads. No significant impacts to important surface resources or other geologic resources would occur under the Proposed Action. Mitigation measures discussed in Section 2.3.4.2.1 and 4.1.2.6 should reduce potential impacts to geologic/paleontologic resources.

Beneficial impacts under the action alternatives include the unanticipated discovery of previously unknown fossils which could occur as a result of construction anywhere in the analysis area. To have beneficial impact, such newly discovered fossils must be properly collected and catalogued into a museum repository so that associated geologic data is preserved and available for future scientific study.

S.2.2 Air Quality

Implementation of the Proposed Action and/or Alternatives A and B would result in the construction and operation of additional well sites in the GWA II analysis area. These actions would not pose a significant air quality impact. The airborne pollutant concentrations that would result from the increased well site emissions would meet all Wyoming and federal ambient air quality standards, and would comply with applicable Prevention of Significant Deterioration (PSD) increments. In addition, the impact to air quality related values (visibility, acid deposition, and soils/vegetation) would be below significance criteria levels. Alternative C, the No Action Alternative, would allow on-going natural gas production activities to continue in the GWA II analysis area, but will not exceed the level of significance criteria. Mitigation measures discussed in Section 2.3.4.2.2 should reduce impacts to air quality.

S.2.3 Soils

Implementation of the Proposed Action and/or Alternatives A and B would initially affect 2,416 acres, 2,015 acres, and 1,613 acres of soils, respectively, during construction. Alternative C, the No Action Alternative could continue to add to the 12,527 acres of existing disturbance in the GWA II analysis area as APDs are granted by the BLM. The majority of the GWA II analysis area falls into a sensitive soils category in regard to topsoil depth and quality, with limitations to road and facilities construction, rapid to very rapid runoff potential, and severe to very severe wind and water erosion potential. Impacts resulting from drill pad, access road, facility site, and pipeline ROW construction could include removal of vegetation, exposure of the soil, mixing of soil horizons, soil compaction, loss of topsoil productivity, and increased susceptibility of the soil to wind and erosion. Although sensitive soils cannot be totally avoided, steep slopes greater than 30 percent, badlands, and soils with high water tables should be avoided. These impacts could be kept to non-significant levels with application of mitigation measures proposed in Section 2.3.4.2.3 and control measures recommended in Appendix B.

S.2.4 Water Resources

Construction of the proposed drill sites under the Proposed Action and Alternatives A and B could include increased surface water runoff and off-site sedimentation due to soil disturbance; increased salt loading and water quality impairment of surface waters; changes in stream discharge due to project disturbance; changes in groundwater levels, quantity, and quality; and channel morphology changes due to road and pipeline crossings. Under Alternative C, water resources within the GWA II analysis area would remain as described in the Affected Environment (Chapter 3). The magnitude of impacts to water resources would depend on the proximity of the disturbance to the drainage channel, slope aspect and gradient, degree and area of soil disturbance, soil character, duration of time within which construction activities would occur, and the timely implementation of mitigation measures. Impacts would likely be greatest shortly after the start of construction activities and would likely decrease in time due to natural stabilization, reclamation, and revegetation efforts. Mitigation measures discussed in Section 2.3.4.2.4 and other mitigation measures outlined in the Soils and Vegetation Sections 2.3.4.2.3 and 2.3.4.2.5 should reduce impacts to water resources.

S.2.5 Vegetation/Wetlands

Implementation of the Proposed Action and Alternatives A and B would initially affect 2,416 acres, 2,015 acres, and 1,613 acres of various vegetation cover types, respectively, during project construction. This would add to the existing 12,527 acres of existing disturbance in the GWA II analysis area. Direct impacts include the short-term loss of vegetation (modification of structure, species composition, and areal extent of cover types). Indirect impacts include the short-term and long-term increased potential for weed invasion, establishment, and expansion; exposure of soils to accelerated erosion; shifts in species composition and/or changes in vegetative density; reduction of wildlife habitat; and changes in visual aesthetics. Under Alternative C - No Action, vegetation would continue to be impacted as APDs are granted by the BLM on a case-by-case basis. Except for waters of the U.S. and/or plant species of concern and their habitat, a reduction in vegetation density would not be significant because upland vegetation types are relatively common, cover large areas, have wide distribution and occur with high frequency within the project area. Although project implementation could potentially impact the area and functions of wetlands, measures imposed by the RMP and the CWA 404 permitting process would prevent or avoid impacts to jurisdictional wetlands and other special aquatic sites. All alternatives have potential to affect plant species of concern or habitat for such species. Given implementation of Chapter 2 measures and mitigation, no significant impacts are anticipated. Reclamation would be accomplished according to a site-specific reclamation and revegetation plan that uses best management practices.

S.2.6 Range Resources and Other Land Uses

Implementation of the Proposed Action and Alternatives A and B, would initially remove 2,416 acres, 2,015 acres, and 1,613 acres, respectively, from forage production during the construction phase of development operation. Under Alternative C - No Action, the conditions described in Chapter 3, under Affected Environment, would generally remain unchanged except for disturbances due to vehicular use. Impacts to the range resource would involve loss of livestock forage, potential for livestock loss through theft or vehicular collision, and the introduction of weed species. Most of these impacts would be short-term, lasting only as long as construction activities were on-going. Once production operations are underway and reclamation measures completed, impacts to livestock operations would be minimal. Mitigation measures proposed by UPRC and other GWA II operators, as outlined in Chapter 2 and stipulated in the RMP, should reduce or avoid impacts to range resources and other land uses to acceptable levels.

S.2.7 Wildlife

Impacts and potential impacts to wildlife are classified into three basic categories. The first category includes technically significant impacts that have the potential to occur but would be unlikely to occur if prescribed avoidance measures are implemented. These impacts include: 1) long-term loss of sage grouse nesting habitat; 2) increase in potential for vehicle/wildlife collisions; and 3) long-term loss of crucial big game winter range.

Category 2 includes technically significant impacts that would occur but that could be reduced to non-significant levels through the application of prescribed mitigation measures. Category 2 impacts include: 1) increased potential for illegal kill and harassment of wildlife; 2) potential for disruption of raptor and sage grouse nesting activities; 3) potential to adversely impact black-footed ferrets; 4) potential for displacement of pronghorn from crucial winter range; and 5) potential to adversely affect nesting ferruginous hawks, mountain plovers, loggerhead shrikes, and white-faced ibises.

Category 3 includes other important, but technically non-significant potential impacts for which avoidance or mitigation measures may or may not have been prescribed. Category 3 impacts include: 1) long-term and short-term losses of non-crucial habitat of wildlife; and 2) temporary displacement of wildlife during the construction period.

Although the nature of potential impacts to wildlife is identical between the Proposed Action and Alternatives A and B, the potential magnitude of impacts is highest under the Proposed Action, intermediate under Alternative A, and least under Alternative B. This is because of the difference in the number of wells and the associated increase in miles of new roads and pipelines constructed under each alternative. Implementation of Alternative C would maintain the current level of human activity and associated impacts. Given the application of prescribed avoidance and mitigation measures listed in Section 2.3.4.2.7, Appendix A, and under individual species in Section 4.7, significant impacts to wildlife are not expected.

S.2.8 Fisheries

Although the intermittent tributary drainages on the GWA II analysis area do not support fish populations, the Proposed Action and Alternatives have the potential to affect fish resources and associated values if construction and drilling activities result in: 1) increased stream sedimentation; 2) downstream water pollution from accidental discharge of toxic substances; and 3) water flow depletions from Muddy Creek or the Little Snake River. Potential impacts to fisheries resources include the degradation of surface water quality, an increase in stream flow from surface runoff, and a decrease in stream flow from the consumption of groundwater. However, given the avoidance and mitigation measures proposed by UPRC, and those described both in Section 4.8, and in the 1988 BLM Medicine Bow-Divide Resource Management Plan, no significant impacts are expected.

Because endangered and candidate species are so far removed from the GWA II analysis area, no direct effects to fisheries are anticipated. With implementation of the mitigation measures contained in Section 4.8 and in Chapter 2, no adverse residual impacts to fisheries are expected.

S.2.9 Recreation

Well drilling, testing and production operations, and associated site preparation and construction activities such as those proposed for GWA II analysis area have the potential to cause substantial alterations to the recreation setting and recreation opportunities available. Some recreationists could be temporarily or permanently displaced from using certain locations associated with drilling and production activities. Although user displacement would not occur at significant levels, levels of satisfaction with recreation experiences would be reduced due to the redistribution of recreation use patterns and resultant crowding in some locations and increased exposure to noise, dust, vehicle traffic, as well as land and visual disturbances associated with project activities. The Proposed Action as well as Alternatives A and B would have adverse impacts on recreation resource conditions in the project area, despite the measures outlined in Chapter 2 and the RMP (USDI-BLM 1990a) stipulations. Short-term impacts would be identical for the Proposed Action and Alternatives A and B during the initial two-year development period. Impacts would still persist but at reduced levels over the longer term for the Proposed Action, and to a lesser degree for both Alternatives A and B. Implementation of the No Action Alternative (C) would result in the continuation of existing recreation conditions and activity patterns in the GWA II analysis area.

S.2.10 Visual Resources

Short-term impacts would occur from well construction due to contrasts in line, form, color, and texture associated with equipment and surface disturbance juxtaposed with the existing landscape. Long-term impacts would result from production facilities, access roads, and fugitive dust. The severity of impact depends on scenic quality, sensitivity level, and distance zone of the affected environment, reclamation potential of the disturbed area, and level of disturbance to the visual resource created by the project construction. Under the Proposed Action, impacts would be greatest since this alternative proposes the largest number of wells developed. The Proposed Action and Alternative A could produce significant impacts if all potential well locations in the Class 3 zone, I-80/Wyoming Highway 789 viewshed were developed. Impacts for Alternatives B and C would not be considered significant, but would detract from the experience of motorists, Amtrak passengers, and backcountry recreationists.

S.2.11 Cultural Resources

The GWA II cultural resource database includes at least 1,935 sites, consisting of both prehistoric and historic components. Prehistoric sites in the study area are predominantly open camps, lithic scatters, and features not associated with portable cultural material. Historic site types include historic trails, stage stations, railroad grades and stations, townsites, ranches, and cabins. Potential impacts to specific eligible or unevaluated properties are unknown at this time. In general, the GWA II analysis area has a moderate to high site density, and therefore, high archaeological sensitivity. Certain geomorphic situations have a greater archaeological potential than other areas especially in terms of significant cultural resources. These situations include eolian deposits (sand dunes, sand shadows and sand sheets), alluvial deposits along major drainages, and colluvial deposits along the low slopes of Delaney Rim.

Although the GWA II analysis area has a high degree of archaeological sensitivity, impacts to cultural properties would not be significant. Potential impacts to known and anticipated cultural resources can be alleviated through mitigation measures outlined in Chapter 2 and Chapter 4 of this EIS. With implementation of mitigation measures discussed in Sections 2.3.4.2.11 and 4.11.6, no significant impacts to cultural resources would occur in the analysis area.

S.2.12 Socioeconomics

Although neither the Proposed Action nor any of the alternatives would stimulate extremely rapid growth, potential adverse effects may occur, particularly in the town of Wamsutter. Socioeconomic impacts which could arise under the Proposed Action include short-term difficulties involving housing supply, public service provision, and general adjustment problems associated with rapid social and economic change. Alternative A would have these same impacts during the initial 1994-1996 project phase, with much-reduced impacts thereafter depending on the pace of project development. Alternative B would also produce similar effects during the initial 1994-1996 drilling and construction period, but would have only limited effects thereafter. None of the Action Alternatives are likely to generate widespread dissatisfaction or organized opposition among area residents. Implementation of Alternative C - No Action, would continue the existing socioeconomic conditions and trends in the communities located in and around the project area. In addition to measures listed in Section 2.3.4.2.10, mitigation procedures described in Section 4.11.6, and stipulations outlined in the RMP, efforts to accommodate the potentially significant socioeconomic impacts associated with this project would be addressed.

S.2.13 Transportation

Transportation effects of the Proposed Action and Alternatives A and B, would occur primarily on U.S. Interstate 80 (I-80), Wyoming Highway 789 (WY 789), and Sweetwater County Road 4-23. Under the Proposed Action and Alternatives A and B, traffic volumes would increase on highways leading to the analysis area as well as on county and operator maintained roads. These increases would result from movement of workers, equipment and materials to and from the analysis area to perform drilling, field development, well service, field operations and reclamation activities. Alternative C - No-Action would result in transportation conditions similar to those described in Chapter 3 (Section 3.13). These impacts associated with the Proposed Action and Alternatives A and B would occur throughout the life of the drilling program, but due to the good condition and excess capacity of the highways within the analysis area, these impacts are not considered significant.

S.2.14 Health and Safety

Hazards associated with the drilling program, including construction and operation, are hazards normally associated with heavy construction and industrial work. Potential risks associated with the oil and gas extraction industry, including impacts from road, drill site, and pipeline construction, drilling operations, production operations and project traffic, would mostly be limited to employees and subcontractors. There would be a minor increased risk to the public caused by project implementation resulting from additional drilling and production related traffic in the GWA II analysis area. However, none of these impacts are expected to occur at significant levels. With implementation of mitigation measures in Section 2.3.4.2.14, no significant impacts should occur with respect to health and safety.

S.2.15 Noise

Implementation of the Proposed Action and Alternatives A and B has the potential to create noise-generated impacts that emanate from machinery utilized during the construction of drill sites, pipelines, access roads, and ancillary facilities, and from the operation of heavy trucks and related equipment. Given the low human population densities in the GWA II analysis area, construction and development operations under the Proposed Action and Alternatives A and B would be sufficiently distant from residences that none would likely be affected by construction or development operations. Under the No Action Alternative, Alternative C, no additional noise levels would be added to already existing noise in the analysis area. Overall noise produced by construction and support services equipment during peak activity periods would be moderate because of its dispersed and short-term nature. Implementation of mitigation measures in Sections 2.3.4.2.15 and 4.15.6 should fully mitigate/reduce noise impacts to acceptable levels.

S.3 SCOPE OF ANALYSIS

The purpose of the scoping process, as stipulated (40 CFR, Parts 1500-1508), is to identify important issues, concerns, and potential impacts that require analysis in the EIS and to eliminate insignificant issues and alternatives from detailed analysis. A Scoping Statement was prepared and submitted to the public by the BLM on December 13, 1993, requesting input into the proposed GWA II natural gas development project. A total of 130 scoping documents were sent out to the public on the BLM mailing list, as well as to organizations, groups, and individuals requesting a copy of the scoping document. During preparation of the EIS, the BLM and consultant Interdisciplinary Team (IDT) had communicated with, and received input from various federal, state, county, and local agencies, elected representatives, environmental and citizen groups, industries, and individuals potentially concerned with issues regarding the proposed drilling action as summarized in Chapter 5.

CHAPTER 1

PURPOSE AND NEED

CHAPTER 1

PURPOSE AND NEED

1.0 INTRODUCTION

Pursuant to the National Environmental Policy Act (NEPA) process, this chapter discusses the purpose and need for the proposed gas development project in the Greater Wamsutter Area II (GWA II). The project description and location and other pertinent background information, including issues of concern identified regarding the proposed project, are also included in this chapter.

1.1 PROJECT DESCRIPTION AND LOCATION

1.1.1 Description

Union Pacific Resources Company (UPRC) has notified the Bureau of Land Management (BLM), Great Divide Resource Area, that the company and other operators, including Amoco Production Company (Amoco) intend to drill additional development wells in the Greater Wamsutter Area (GWA) of south central Wyoming (Exhibits 1-1 and 1-2). Lands associated with the additional drilling program include those previously analyzed in the GWA Natural Gas Project Environmental Assessment (EA) (USDI-BLM 1992a), and additional mixed Federal and private lands located north of Interstate 80 (I-80) as shown on Exhibit 1-3. The additional area has been combined with the previously analyzed area to form the Greater Wamsutter Area II (GWA II analysis area).

1.1.2 Location

The GWA II analysis area is located in southeastern Sweetwater County and southwestern Carbon County, Wyoming, within Townships 16 through 22 North (T16-22N), Ranges 92 through 95 West (R92-95W), 6th Principal Meridian. The GWA II analysis area is accessed by I-80, which crosses the north-half of the area (Exhibit 1-1), and by Wyoming State Highway 789, located to the east of the analysis area. Additional access is provided to the interior of the GWA II analysis area by an existing road network developed to service prior and ongoing drilling and production activities.

1.1.3 Project Background

Presently, the GWA contains several active natural gas fields and federal units, some of which have active drilling programs (Tables 1-1 and 1-2). These fields are subject to spacing regulations authorized by the Wyoming Oil and Gas Conservation Commission (WOGCC). Required spacing within established fields in the GWA is summarized in Table 1-2.

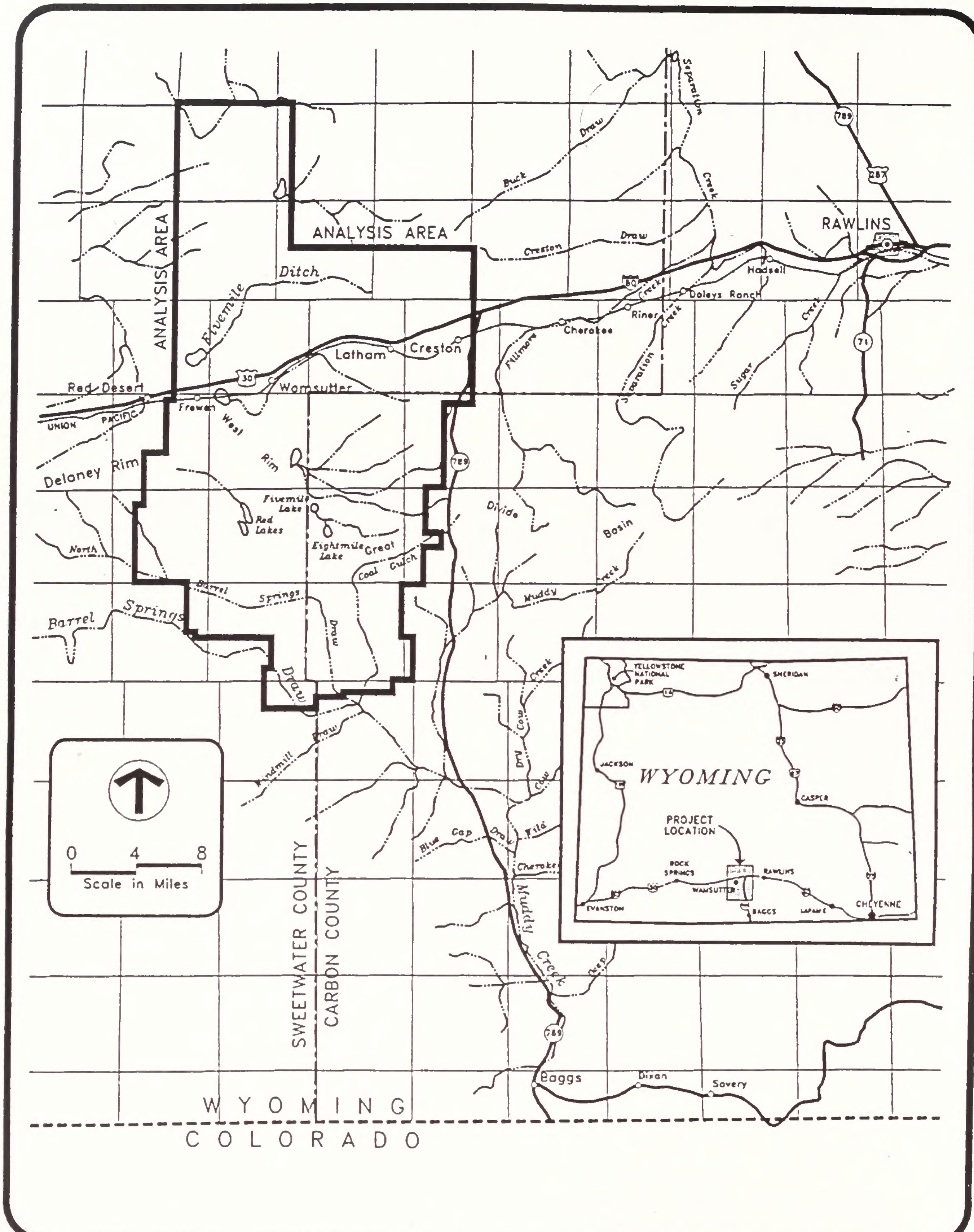

Exhibit 1-1. Area Map - Location of the GWA II Analysis Area in South Central Wyoming.

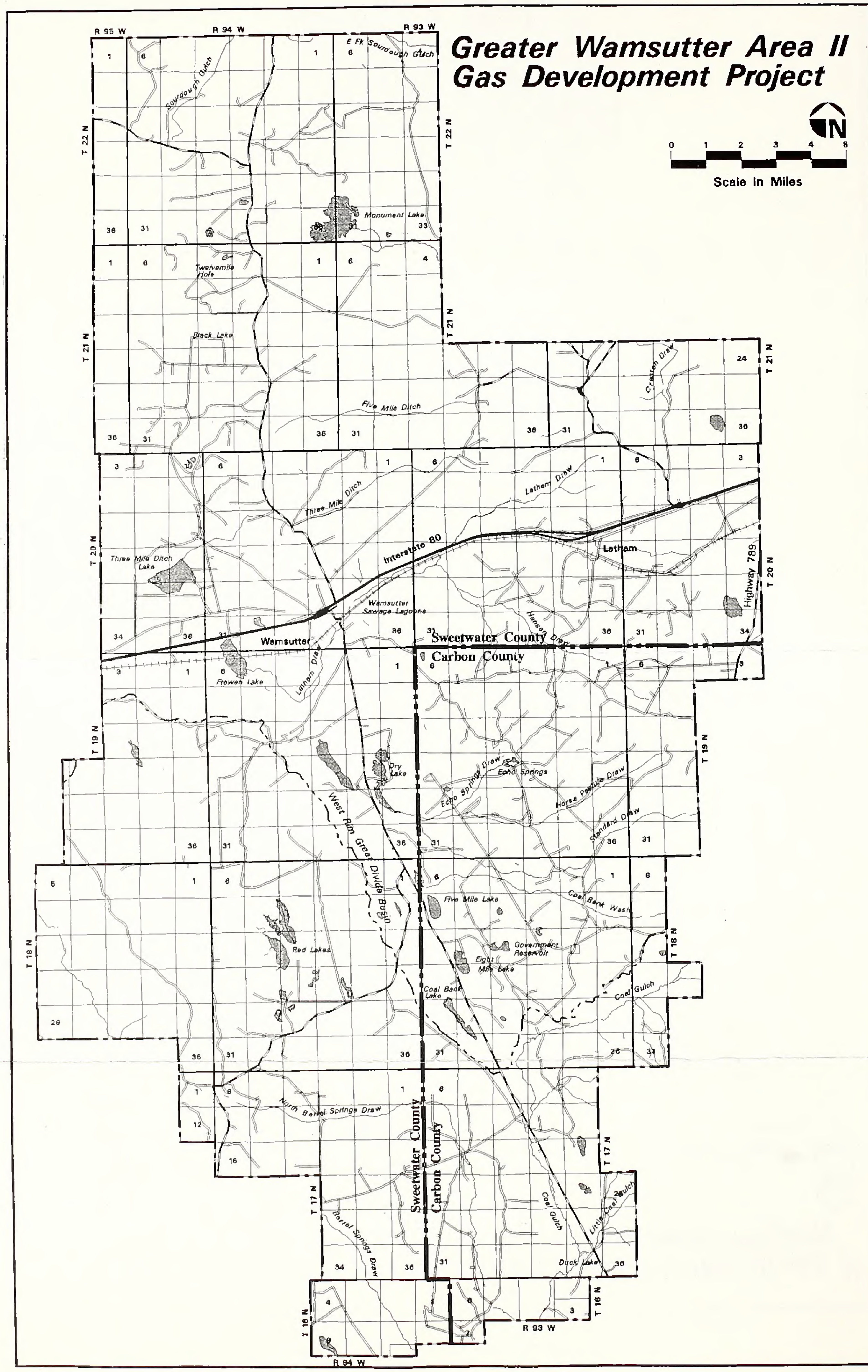

Exhibit 1-2. Vicinity Map - Geographic Features in the Vicinity of the GWA II Analysis Area.

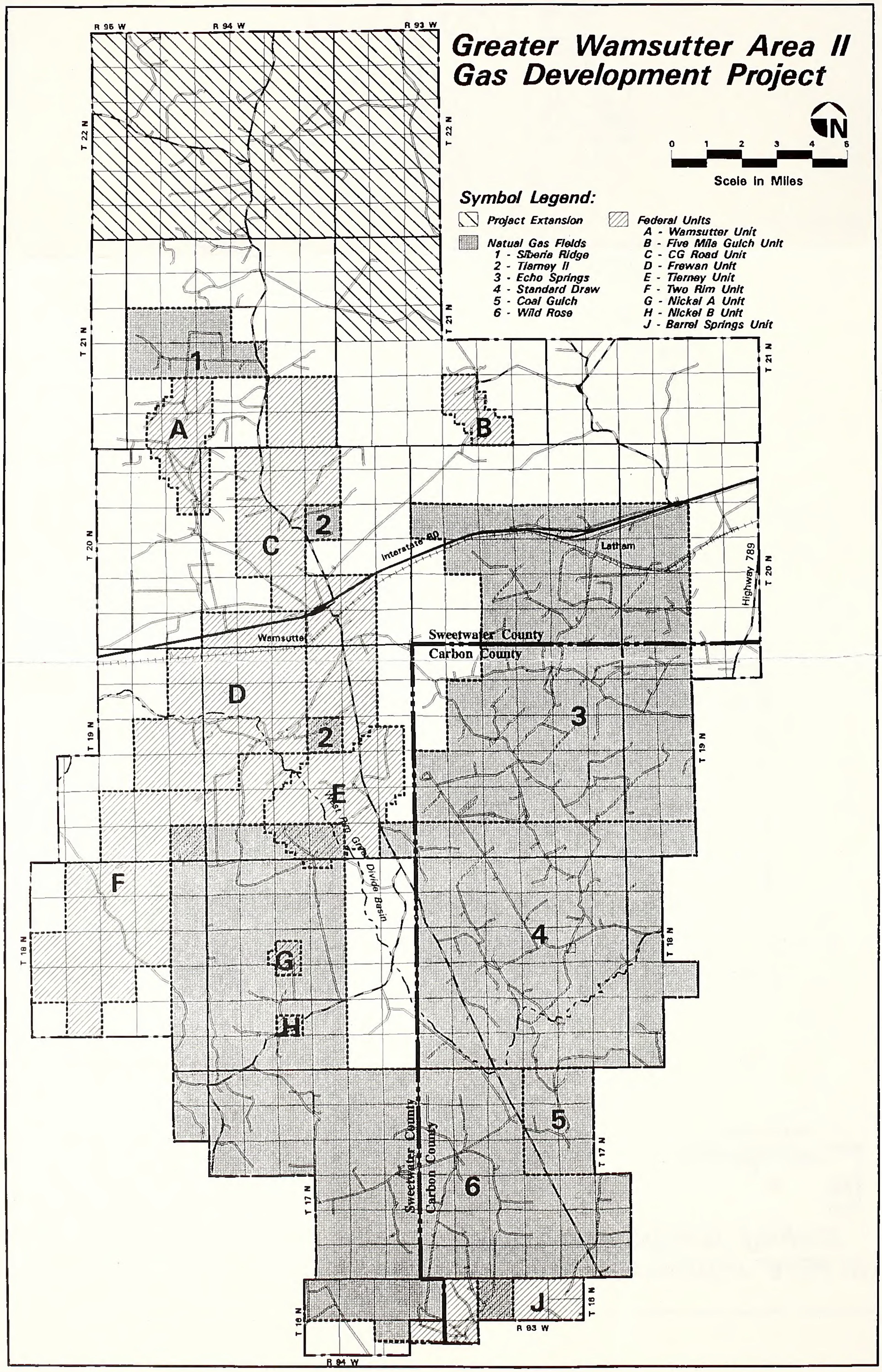

Exhibit 1-3. Map Showing Locations of Units/Spacing Orders in the GWA II Analysis Area.

Table 1-1. Federal Units within the GWA II Analysis Area.

Name	Operator	Size (acres)	Date Designated
C.G. Road Unit	Barrett Resources Co.	15,115	4/30/91
Five Mile Gulch Unit	Amoco Production Co.	24,936	8/6/76
Frewen Unit	Barrett Resources	12,209	1/31/89
Nickel Unit	Kaiser-Francis Oil Co.	13,439	8/19/77
Tierney II Unit	Marathon Oil Co.	7,661	7/21/77
Two Rim Unit	Barrett Resources Co.	14,994	4/30/91
Wamsutter Unit	Marathon Oil Co.	3,858	12/5/57

Table 1-2. Fields (Spacing Orders) within the GWA II Analysis Area.

Field Name	Required Spacing	Producing Interval	Date of Order
Echo Springs Field	2 per 640 acres	Mesaverde	Mar. 11, 1992
Standard Draw Field	2 per 640 acres	Mesaverde	April 13, 1994
Coal Gulch Field	2 per 640 acres	Mesaverde	April 13, 1994
Wild Rose Field	2 per 640 acres	Mesaverde	May 13, 1992
Siberia Ridge Field	Statewide Rule 302	Mesaverde	April 13, 1994

In addition to the required spacing shown in Table 1-2, UPRC received approval from the WOGCC in April, 1994 to de-space seven sections in the Siberia Ridge Field. The spacing order provides for the drilling of an optional second, third, and fourth additional well in each 640 acre unit from the Mesaverde Group.

Other development wells within the GWA II that are not included in a field or federal unit would be drilled on the spacing pattern established by WOGCC Rule 302 for unspaced areas. Specific information regarding Rule 302 is found in the Operational Rules, Wyoming Oil and Gas Conservation Commission, Section 302, Location of Wells.

Currently, natural gas drilling and development activities on public lands within the GWA are authorized by the approved GWA EA. The GWA EA analyzed three separate natural gas production and development alternatives. Alternative A provided for UPRC and the other operators to drill 44 production wells within the GWA in addition to existing operations. Alternative B provided for UPRC and the other operators to drill 70 production wells in addition to existing operations. These two alternatives provided a minimum development scenario (44 production wells with related roads, pipelines, and production facilities) and a maximum development scenario (70 production wells and related facilities). The 44 wells were to be drilled during 1992, and the remaining wells drilled over some unspecified time period through 1993 and several years beyond. Both Alternative A and Alternative B were feasible actions proposed by UPRC and the other GWA operators. The third alternative considered was Alternative C, "No Action." This alternative implied that the BLM would allow ongoing natural gas production activities in the GWA to continue with additional applications for permit to drill (APDs) being granted by the BLM on a case-by-case basis. The wells analyzed under each alternative were located on federal (BLM), State, and private surface lands.

The Decision Record and Finding of No Significant Impact (August 1992) (USDI-BLM 1992a) for the GWA Natural Gas Project provided for permitting the maximum development pattern of 70 new production gas wells within the GWA II analysis area and associated access roads, pipelines, and other ancillary facilities. The BLM's decision related primarily to federal lands administered by the BLM, although decisions by other jurisdictions to issue approvals related to this proposal could be aided by the disclosure of impacts presented in the GWA EA.

Since completion of the EA, 70 wells have been drilled by UPRC and other operators. In addition, several wells (approximately 20) beyond the 70 well program have been drilled on private leases since the BLM's decision was implemented. This additional drilling is due in part to spacing exceptions being granted in the Standard Draw, Coal Gulch, and Wild Rose fields by the WOGCC (Table 1-2). In addition, a few wells were drilled on federal leases because of potential oil and gas drainage concerns that were created by the new wells located on private surface lands adjacent to the federal leases. Current plans by GWA operators call for additional production well drilling and development within the GWA.

The BLM has advised UPRC and the other GWA II operators that an environmental impact statement (EIS) of the GWA II would be initiated in view of UPRC and other operators' plans to drill additional infill locations and construct ancillary facilities within the GWA II analysis area in 1995 and beyond, at levels not analyzed in the GWA EA.

1.1.4 Land Status

The GWA II analysis area encompasses 334,191 acres of mixed federal, state, and private lands. Of this total, approximately 146,912 acres are federal, 19,240 acres are State of Wyoming, and 168,039 are private lands. Surface ownership is shown on Exhibit 1-4 and summarized in Table 1-3.

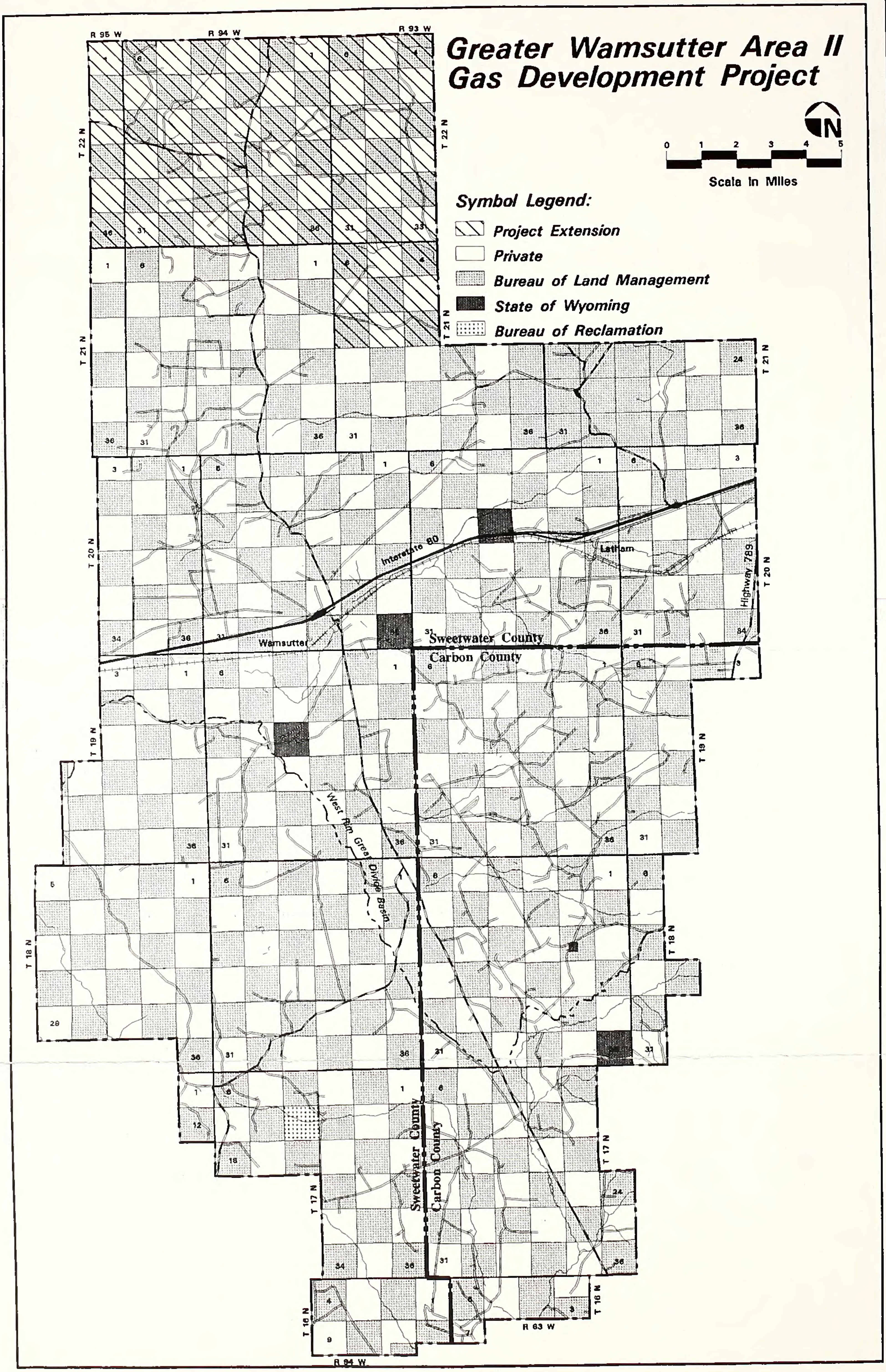

Exhibit 1-4. Surface Ownership within the GWA II Analysis Area.

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Table 1-3. Surface Ownership of the GWA II Analysis Area.

Surface Ownership	Acres	Percent
Private	168,039	50.3
Federal (BLM)	146,912	43.9
State of Wyoming	19,240	5.8
TOTAL	**334,191**	**100.0**

Prior to commencement of drilling and production operations on lands analyzed previously in the GWA EA, the GWA contained 217 active producing wells, with accompanying production-related facilities, roads, and pipelines. Field investigation of oil and gas disturbances in the GWA II area indicates that total disturbance associated with well sites averages approximately 5.0 acres per site for a total of 1,085 acres of disturbance. Similarly, field investigation revealed approximately 0.5 miles of combined pipeline/road ROW per well site or 108.5 miles total. The average disturbance for the combined ROW was approximately 50 feet, resulting in a total disturbance of 660 acres. See Sections 2.7.2 and 4.3.5 for a more comprehensive assessment of oil and gas development disturbance. These figures represented an environmentally conservative scenario as an undetermined portion of the well sites and ROWs have been reclaimed or are in varying stages of reclamation. Based on the above assumptions, approximately 1,745 acres of site disturbance existed within the GWA prior to approval of the GWA EA. This figure represented 0.6 percent of the total GWA surface area of 295,791 acres.

The GWA EA approved the drilling of an additional 70 wells and construction of associated access roads, pipelines, and other ancillary facilities. Total disturbance associated with the additional 70 wells and ancillary facilities is estimated at 562 acres. Currently then, it is estimated that approximately 2,307 acres of site disturbance exists within the GWA II analysis area (1,745 acres + 562 acres), or 0.70 percent of the total GWA II surface area of 334,191 acres, due to previous oil and gas development and due to the disturbance associated with the 70 wells authorized in the GWA EA. As discussed in Section 2.7.2, additional disturbance beyond that just described occurs in the GWA II analysis area.

1.2 PURPOSE AND NEED FOR ACTION

The purpose of, and need for natural gas development is to exercise the lease holders' rights within the GWA II analysis area to drill for, extract, remove, and market natural gas products and associated fluids in the lands described within the area. Included is the right to build and maintain necessary improvements, subject to renewal or extension of the lease or leases in accordance with the appropriate authority. The primary term of leases within the GWA II analysis area may be for 5 or 10 years. Once production is established, the lease or leases are held as long as the wells are productive.

Private exploration and development of federal oil and gas leases is an integral part of the BLM's oil and gas leasing program under authority of the Mineral Leasing Act of 1920. The overall oil and gas leasing program is needed to encourage development of domestic oil and gas reserves to reduce the United States' dependence on foreign energy supplies.

The United States' dependence on imported oil led Congress to encourage the exploration and development of alternative sources of domestic fuel. In 1980, Congress enacted legislation that included Section 29 of the Crude Oil Windfall Profit Tax Act, which provided an income tax credit to producers of qualified fuels. Section 29 credit is a credit against federal income taxes in the year that the gas is sold.

Natural gas produced from "tight formations" was designated as a qualified fuel under the Section 29 tax credit. These formations normally have low permeability and low flow rates that require expensive recovery techniques to stimulate production. Production of tight formation gas is considered "non-conventional" production because of the difficulty encountered in gas recovery. The Section 29 tax credit was the economic incentive that stimulated natural gas drilling within the GWA by the GWA operators. The accelerated drilling program conducted by UPRC and other GWA operators was authorized by the GWA EA as discussed above.

With the termination of the Section 29 Tax Credit on December 31, 1992, many properties in the GWA II analysis area have become marginal for development. Some operators in the GWA II analysis area are undergoing experimental drilling and completion programs to explore new techniques for cost effective development of these properties. If industry should become successful in these efforts, drilling activities within the GWA II analysis area are expected to increase, thus providing UPRC and the other GWA II operators with the opportunity to continue the development of proven oil and gas reserves in the Echo Springs, Standard Draw, Wild Rose, and Coal Gulch Fields. Successful experimental drilling methodologies could also open up additional drilling opportunities in other Federal Units, such as Tierney II, C.G. Road Unit, Frewen Unit, Two Rim Unit, and Wamsutter Unit as well as the remainder of the Wild Rose Field.

1.3 PURPOSE OF THE ENVIRONMENTAL ANALYSIS PROCESS

The purpose of this EIS is to provide the decision-makers with information needed to make a final decision that is fully informed and based on factors relevant to the proposal. It also serves as the summary documentation of analyses conducted on the proposal and alternatives in order to identify environmental impacts and mitigation measures necessary to address issues. The EIS also provides a vehicle for public review and comment on the GWA II proposal, the environmental analysis, and conclusions about the relevant issues.

This EIS documents the analysis of the effects of drill site locations, access roads, production facilities, pipelines, and other facilities associated with natural gas development on resources and land use within the GWA II analysis area.

1.4 ENVIRONMENTAL ANALYSIS PROCESS

The BLM, as authorized by the Council for Environmental Quality (CEQ) and the National Environmental Policy Act (NEPA) directives, analyzes actions involving federal leases as to their impact on the human environment (40 CFR, Parts 1500-1508). The analysis is to determine whether approval of the action would constitute a "major" federal action necessitating preparation of an EIS. The analysis uses an accepted process for evaluating and disclosing the potential environmental consequences of the proposed action and alternatives.

The BLM, Rawlins District, Rawlins, Wyoming is the lead agency responsible for preparation of this EIS. The evaluation of this proposal and alternatives was developed through interdisciplinary field review with representatives from GWA II operators, the BLM, and the project interdisciplinary team (IDT).

The factors considered during the environmental analysis process regarding the natural gas production project include the following:

- The location of environmentally suitable drill sites, access roads, pipelines, and production facilities that best meet other resource activities and minimize surface resource impacts while honoring the lease rights within the analysis area.

- A determination of impacts resulting from the proposed action and alternatives on the human environment if conducted in accordance with applicable regulations and lease stipulations, and the development of mitigation measures necessary to avoid or minimize these impacts.

This EIS is not a decision document; it documents the process used to analyze the environmental effects of the proposed natural gas production project and alternatives to the proposed project. The decision regarding the project will be documented in a Record of Decision signed by the BLM District Manager, Rawlins District. The BLM decision will relate primarily to federal lands administered by the BLM. Decisions by other jurisdictions to issue approvals related to this proposal may be aided by the disclosure of impacts available in this analysis.

This EIS will guide the implementation of a selected alternative and will facilitate preparation of additional environmental analyses within the analysis area and adjacent lands for project-specific facility locations. This EIS is not the final environmental review upon which approval of all actions in the GWA II analysis area will be based. Site-specific environmental analyses will be required for each drill site and associated roads and pipelines located on public lands.

1.5 RELATIONSHIP TO POLICIES, PLANS, AND PROGRAMS

1.5.1 Conformance With Land Use Plan

The document that directs management of federal lands within the GWA II analysis area is the Record of Decision and Approved Resource Management Plan (RMP) for the Great Divide Resource Area (USDI-BLM 1990a). Management objectives and actions applicable to the proposed action and alternatives within the Great Divide Resource Area follow.

1.5.2 Management Objective

To provide opportunity for leasing, exploration, and development of oil and gas while protecting other resource values.

1.5.3 Management Actions

The entire planning area is open to oil and gas leasing. Leases will be issued with the necessary restrictions to protect resources.

The proposed natural gas production project is in conformance with management objectives provided in the Great Divide Resource Area RMP.

1.5.4 Standard Mitigation Guidelines for Surface-Disturbing Activities

Wyoming BLM Standard Mitigation Guidelines for Surface Disturbing Activities are incorporated into the oil and gas leases within the GWA II analysis area. The purposes of these guidelines are 1) to reserve, for the BLM, the right to modify the operations of surface and other human presence disturbance activities for environmental protection, and 2) to inform a potential lessee of the requirements that must be met when using BLM-administered public lands. Standard mitigation guidelines applicable to the proposed natural gas production operations within the GWA II analysis area are presented in Appendix A.

1.5.5 Relationship to Other Plans and Documents

Other environmental analyses completed or planned for completion on public lands in the immediate vicinity of the GWA II analysis area include the documents listed below.

- Greater Wamsutter Area Natural Gas Project Environmental Assessment (EA) (USDI-BLM 1992a). The Greater Wamsutter Area Natural Gas Project EA analyzed the impacts associated with a maximum development pattern of 70 new production wells within the GWA and associated access roads, pipelines, and other ancillary facilities required on federal lands. Disturbances and other impacts associated with this project are included in the GWA II Environmental Impact Statement (EIS) to fully evaluate potential cumulative impacts.

- Mulligan Draw Environmental Impact Statement (USDI-BLM 1992b). This document was completed in August 1992 and analyzes a planned natural gas production project on public lands adjacent to the southwest side of the GWA II analysis area. Celsius Energy Company and other operators plan to drill approximately 45 total wells on 640-acre spacing over a span of several years to develop the natural gas reserves in the Mulligan Draw field area. Impacts associated with this project are included in the GWA II project EIS to fully evaluate potential cumulative impacts.

- Creston/Blue Gap Natural Gas Project Environmental Impact Statement (USDI-BLM et). This EIS was approved on October 4, 1994, and assessed the environmental consequences of a proposed natural gas development located on the southeastern edge of the GWA II. The BLM's decision allowed a maximum of 275 wells on 250 locations on a 160-acre spacing pattern. Impacts associated with this proposed development will be included in the cumulative impacts analysis in the GWA II EIS.

- Uinta Basin Lateral Pipeline Environmental Assessment (USDI-BLM 1992c). This EA was completed in January 1992 and analyzes impacts associated with construction and use of a 20-inch natural gas pipeline that parallels the west side of the GWA II analysis area. Total length of the proposed pipeline is approximately 222 horizontal miles and would transport natural gas from various supply sources in the Uinta Basin of eastern Utah and the Piceance Basin of western Colorado to natural gas mainlines located near Wamsutter, Wyoming. Potential impacts associated with construction and use of this project will also be included in the cumulative impacts analysis of the GWA II EIS.

- Hay Reservoir Unit Natural Gas Development Environmental Assessment (USDI-BLM 1992d). The Hay Reservoir Unit is a natural gas-producing area located approximately 35 miles northwest of the GWA II analysis area. The Hay Reservoir Unit presently contains 24 natural gas wells. An increase of up to 20 additional wells over the next two years is anticipated to complete the planned development of the Unit. Impacts associated with the Hay Reservoir project are analyzed in this EIS to determine if cumulative impacts may exist resulting from the implementation of this project and the other development projects in the area.

1.6 AUTHORIZING ACTIONS

The federal, state, county, and local actions required to implement the Greater Wamsutter Area II Natural Gas project proposal are listed in Table 1-4.

Table 1-4. Federal, State, and County Authorizing Actions.

Agency	Nature of Action
U.S. Department of Interior	
Bureau of Land Management (Rawlins District)	Approves Application for Permit to Drill (APD), approval to dispose of produced water, Sundry Notices. Approves Unit Area agreements. (Reservoir Management Team, Casper District) Approves gas venting or flaring during testing. Approves disposal of produced water. Grants rights-of-way to Area operators/ lease holder for gas field development actions on BLM surface outside federal unit boundaries, and to third party actions (i.e., non-unit operator or non-lease holder) both within, and outside of the unit boundary. Issues cultural/resource use permits and permits to excavate and remove archeological resources on BLM-administered lands.
U.S. Fish and Wildlife Service	Reviews impacts on federally listed or proposed-for-listing threatened or endangered species of fish, wildlife, plants, and other lifeforms.
U.S. Department of the Army	
U.S. Army Corps of Engineers	Issues Section 404 permit(s) for placement of dredged or fill material into and/or excavation of waters of the United States and special aquatic sites/wetlands.
U.S. Department of Energy	
Federal Energy Regulatory Commission	Regulates interstate pipeline product transport.
U.S. Department of Transportation	Administers pipeline regulations.

Table 1-4. Federal, State, and County Authorizing Actions, Continued.

Agency	Nature of Action
Wyoming Department of Environmental Quality	
Water Quality Division	Administers Storm Water Pollution Prevention Plan (SWPPP). Approves Surface Discharge. Approves sewage treatment facilities (groundwater pollution control permit). Approves resident camp culinary water supply. Approves wastewater disposal.
Wyoming State Engineer's Office	Issues permits to appropriate groundwater and surface water. Issues temporary water rights for construction permits to appropriate surface water.
Wyoming State Historic Preservation Office	Provides consultation concerning inventory of, and impacts to cultural resources.
Wyoming Oil and Gas Commission	Acts as primary authority for drilling on state and privately held mineral resources. Holds authority to allow or prohibit flaring or venting of gas. Regulates drilling and plugging of wells. Issues Aquifer Exemption Permit. Approves directional drilling. Administers rules and regulations governing drilling units. Issues permits to drill and use of blowout prevention. Grants gas injection well permits.

Table 1-4. Federal, State, and County Authorizing Actions, Continued.

Agency	Nature of Action
Carbon County	Provides road use agreements and/or oversize trip permits when traffic on county road exceeds established size and weight limits or where the potential for excessive road damage exists.
Sweetwater County	Administers Encroachment Permit. Grants oil and gas location permits for all drilling locations. Issues small wastewater system permits, where applicable. Issues driveway access permits where new roads intersect with county roads. Provides road use agreements and/or oversize trip permits when traffic on county road exceeds established size and weight limits or where the potential for excessive road damage exists. Issues construction and conditional use permits for all new structures. Administers zoning changes where applicable. Handles filing fees.

1.7 ISSUES AND CONCERNS

Public issues and comments regarding the GWA II Natural Gas project were solicited for incorporation into this EIS through the scoping process. A Scoping Statement that described the actions to be analyzed was prepared and submitted to the public on December 13, 1993. The statement identified preliminary land and resource management issues, concerns, and opportunities, and outlined timing needs for public involvement. Environmental and social issues of local importance associated with natural gas production were identified as follows:

1. The potential for increased erosion hazard resulting from access road, pipeline, and drill site construction activities.

2. Possible adverse impacts to wildlife and other special status species in the analysis area and adjacent lands including the following:

   - Potential impacts to wildlife habitats within the project area and adjacent lands, including big game, sage grouse, raptors, and non-game wildlife species.

   - Potential impact to threatened and endangered, and special status plant and animal species and communities.

3. The number of workers required for the proposed project and the amount of worker accommodations needed to facilitate the work force. Related concerns include whether workers will live in designated camps or commute from surrounding areas and the effect construction activities will have on the local economy.

4. Potential impacts to surface and groundwater resources within the GWA II analysis area and surrounding lands.

5. Cumulative impacts of field development relative to other land and resource activities in the area, both ongoing and proposed.

6. Existing road and gas pipeline problems:

   - Increased traffic and associated impacts on existing county, state, and BLM roads.

   - Utilization of existing road and pipeline corridors rather than construction of new ones (i.e., cumulative site disturbance effects resulting from additional road and pipeline construction within an existing corridor).

7. Impacts to unknown prehistoric and historic values as well as paleontological resources.

8. Disruption of livestock management operations (primarily herding) and potential for loss of suitable range forage within the unit area due to field development activities.

9. Potential impact of emissions resulting from additional drilling and production activities.

10. Reclamation of disturbed areas and control of noxious weed invasions following reclamation.

11. Management concern over the effect of drainage of the federal mineral estate by wells drilled on adjacent private lands and the development of mitigation measures necessary to avoid this impact.

12. Concerns that well drilling, completion, and operation will cause mixing of different quality groundwater, resulting in groundwater quality degradation.

13. Concerns that corrosion of well casings will result in leakage into groundwater and water quality degradation.

14. Concerns that standard operating procedures in regard to well completion are not sufficient to prevent leakage and groundwater quality degradation.

15. Concerns that leakage could cause degradation of mineral resources through contamination.

1.8 OPPORTUNITIES

Opportunities that may arise from the GWA II Natural Gas Production project include the following:

1. The natural gas development project would allow UPRC and other GWA II operators the opportunity to continue development of proven natural gas reserves.

2. UPRC and other operators would explore new drilling and production techniques that would allow for the development of marginal properties. These techniques include the drilling of multiple wells from a single well pad, thus reducing overall surface disturbance within the GWA II analysis area.

3. Potential economic benefits to communities surrounding the GWA II analysis area by providing jobs and a boost to the local tax base.

4. The natural gas field development project could provide the opportunity to develop a domestic energy source that may help lower dependence on foreign sources.

5. The field development project would provide a clean-burning energy resource that could supplement or replace some existing energy sources that are more harmful to the environment.

CHAPTER 2

PROPOSED ACTION AND ALTERNATIVES

CHAPTER 2

PROPOSED ACTION AND ALTERNATIVES

2.0 DESCRIPTION OF ALTERNATIVES

This chapter describes the Proposed Action, other action alternatives, and the No Action alternative analyzed for this EIS. In addition to the Proposed Action, three other alternatives have been developed that contain varying degrees of development, including Alternative C, the No Action alternative which implies that existing drilling activities may continue, but no further gas development or drilling would be allowed. As a rough overview, the Proposed Action would entail development of 750 wells at 300 well sites; Alternative A would entail development of 300 wells at 250 well sites; Alternative B would entail development of 225 wells at 200 well sites; and Alternative C, as indicated above, would disallow further development beyond the level currently authorized.

2.1 SUMMARY

Union Pacific Resources Company (UPRC), Amoco Production Company (Amoco), and other Greater Wamsutter Area (GWA II) gas development field operators (referred to hereafter as "the Operators") have proposed to drill and develop 300 additional well locations (a total of 750 wells) in addition to the existing drilling and production operations within the analysis area (Exhibit 1-2). This program would allow for the continued development of proven natural gas reserves and would provide the Operators the opportunity to explore new drilling and production techniques necessary for the development of marginal properties. With the exception of known reserves in the Echo Springs, Standard Draw, Wild Rose, Coal Gulch, and Siberia Ridge Fields, most of the remaining lands in the analysis area would be considered marginal properties.

This proposal would also provide for full development of the natural gas fields within the analysis area. The precise number of wells, locations of the wells, and timing of drilling would be directed by the success of developing effective drilling and production technologies, and economic considerations such as cost of development of marginal properties. The Operators intend to use several experimental drilling and production techniques as a part of the proposed action to reduce drilling and production costs and to develop marginal properties. These techniques include horizontal drilling, one pad/multi-well directional drilling, and slim hole drilling methods. A description of these techniques is provided in the Plan of Operations discussed in following sections.

Should attempts by the Operators to develop marginal properties within the GWA II analysis area not be totally successful, then the level of drilling and production activity on marginal properties, as described under the proposed action, would be at a reduced level.

Based on this information, this environmental impact statement (EIS) addresses the proposed action and three other alternatives.

- Proposed Action - Allow the Operators to develop 750 wells at 300 well locations within the analysis area in addition to existing operations.

- Alternative A - Allow the Operators to develop 300 wells at 250 well locations within the analysis area in addition to existing operations.

- Alternative B - Allow the Operators to develop 225 wells at 200 well locations within the GWA II analysis area in addition to existing operations.

- Alternative C - "No Action." This alternative implies that ongoing natural gas production activities would be allowed to continue by the Bureau of Land Management (BLM) in the GWA II analysis area, but the proposed full-field development program and the other development alternatives evaluated for this EIS would be disallowed. Additional Applications for Permit to Drill (APD) and Right-of-Way (ROW) actions would be granted by the BLM on a case-by-case basis based on previous BLM authorizations.

The proposed action and two development alternatives would provide a range of development scenarios, from a maximum of 750 wells at 300 locations (including related roads, pipelines, and production facilities) to a minimum development scenario of 225 wells at 200 locations (including related activities and facilities). Should the planned experimental drilling and production techniques prove economically viable, then the minimum (225 wells at 200 locations) would be developed during 1994 through 1996. The remaining wells described in the proposed action would be developed from late 1996 through the year 2005.

Most of these wells would be classified as infill or development wells, being direct offsets to existing wells on previously permitted locations. Of this total, approximately 50 percent of the locations would be drilled on private land. Development plans for the proposed natural gas production project provide for development of the Almond Formation of the Mesaverde Group. The proposed action and alternatives are further described in the following section.

2.2 PROPOSED ACTION - ALLOW THE OPERATORS TO DRILL AND DEVELOP AN ADDITIONAL 750 WELLS (AT 300 LOCATIONS) WITHIN GWA II

With finalization of the Echo Springs Field development drilling program by UPRC, and the de-spacing of Standard Draw, Coal Gulch, Wild Rose, and Siberia Ridge Fields, 225 of the proposed 750 wells with known gas reserves would be drilled first under the proposed action. Finalization of the development drilling programs in these fields would begin in 1994 and continue through 1996. The proposed drilling program would be conducted on existing Wyoming Oil and Gas

Conservation Commission (WOGCC) approved spacing within the GWA II analysis area. WOGCC Rule 302 would be adhered to in areas that are not spaced.

Experimental drilling programs such as horizontal drilling and single pad/multi-well directional drilling are currently used in the GWA II analysis area, and are regulated by WOGCC approved spacing based on the bottom-hole locations. Other concepts currently being tested and developed for effectiveness include the use of single pad/multi-well production facilities which provides one central location capable of servicing several producing wells. Enhanced techniques for stimulation of these wells are being tested to increase production. If the GWA II operators are successful in these efforts, the long range proposed action of 750 wells at 300 locations would be representative of drilling and production activities through the year 2005.

Specific components of the GWA II Natural Gas Production program are described in the Master Surface Use and Operating Plan, Appendix C, and summarized in the following sections of the GWA II Plan of Operations. Additional site-specific information would be contained in the individual well APD and/or ROW application when submitted to the BLM.

2.3 PLAN OF OPERATIONS

2.3.1 Preconstruction Planning and Site Layout

The Operators would follow the procedure outlined below to gain approval for the proposed activity on federal public lands within the GWA II analysis area (other than standard design and construction methods--e.g., road construction per BLM Manual 9113 standards). Development activities proposed on fee and State of Wyoming surface would be handled by the Wyoming Oil and Gas Conservation Commission (WOGCC). The State of Wyoming permitting procedures are different than those described below.

- Prior to the start of construction activities, the Operators would submit an APD/Sundry Notice/ROW Application to the BLM with a map showing the specific location of the proposed activity, (e.g., individual drill sites, pipeline corridors, access roads, or other facilities). The application also includes site-specific construction plans.

- The proposed facility is staked by the applicant and inspected by an official from the BLM to ensure consistency with plans in the APD/Sundry Notice/ROW Application.

- Construction plans for the proposed development would then be negotiated by the BLM and the applicant (i.e., the Operators), if necessary, to resolve any differences that may exist concerning construction standards, required mitigation, etc. Negotiations would be based on the field inspection findings and would take place either during or after the BLM inspection.

- The applicant would revise the APD/Sundry Notice/ROW Application as necessary per negotiations with the BLM. The BLM would then approve the specific proposal and attach the terms and conditions of Approval to the permit. The applicant could then commence with the proposed activity.

Following is a general discussion of proposed construction techniques to be used by the Operators. These construction techniques would be applicable to all drill site, pipeline, and access road proposals within the GWA II analysis area.

2.3.2 Construction and Drilling Phase

2.3.2.1 Well Pad Design

The traditional single-well pad would continue to be constructed in those areas within the GWA II analysis area where gas production is already developed on the single-well-per-pad design (i.e., in those spacing orders or fields where two wells per section are allowed and one of the wells has been drilled and producing, the second well would also be a traditional single well since additional multiple wells would not be authorized as per terms of the approved spacing order). The traditional single-well pad design (Exhibit 2-1) has been utilized almost exclusively in the past in the analysis area.

Some surface locations within the GWA II analysis area are not feasible to occupy for economical (e.g., high road construction costs), physical (e.g., steep terrain), or other environmental reasons (e.g., areas of crucial wildlife winter range). A drilling method to be utilized by the Operators to access bottom-hole locations in these areas is directional drilling from a single-well pad (multi-well, directional drilling).

The single pad/multi-well design (Exhibit 2-2) provides for construction of one well pad with as few as two or as many as four wells drilled from a central location. The first well is usually drilled as a vertical well and the remaining wells are drilled directionally. This design and setup provides a centralized common production facility. Another advantage to single pad/multi-well drilling is the use of common facilities: one access route for multiple wells along with common gathering, separation, storage, and transportation facilities. As such, multi-well drilling techniques would minimize surface disturbance and centralize production facilities. Also, with multi-well drilling, several wells can be serviced at one time with one trip, thus minimizing vehicular traffic, dust control, and disturbance to wildlife. Section 2.3.2.4 discusses standard vertical drilling and directional drilling techniques.

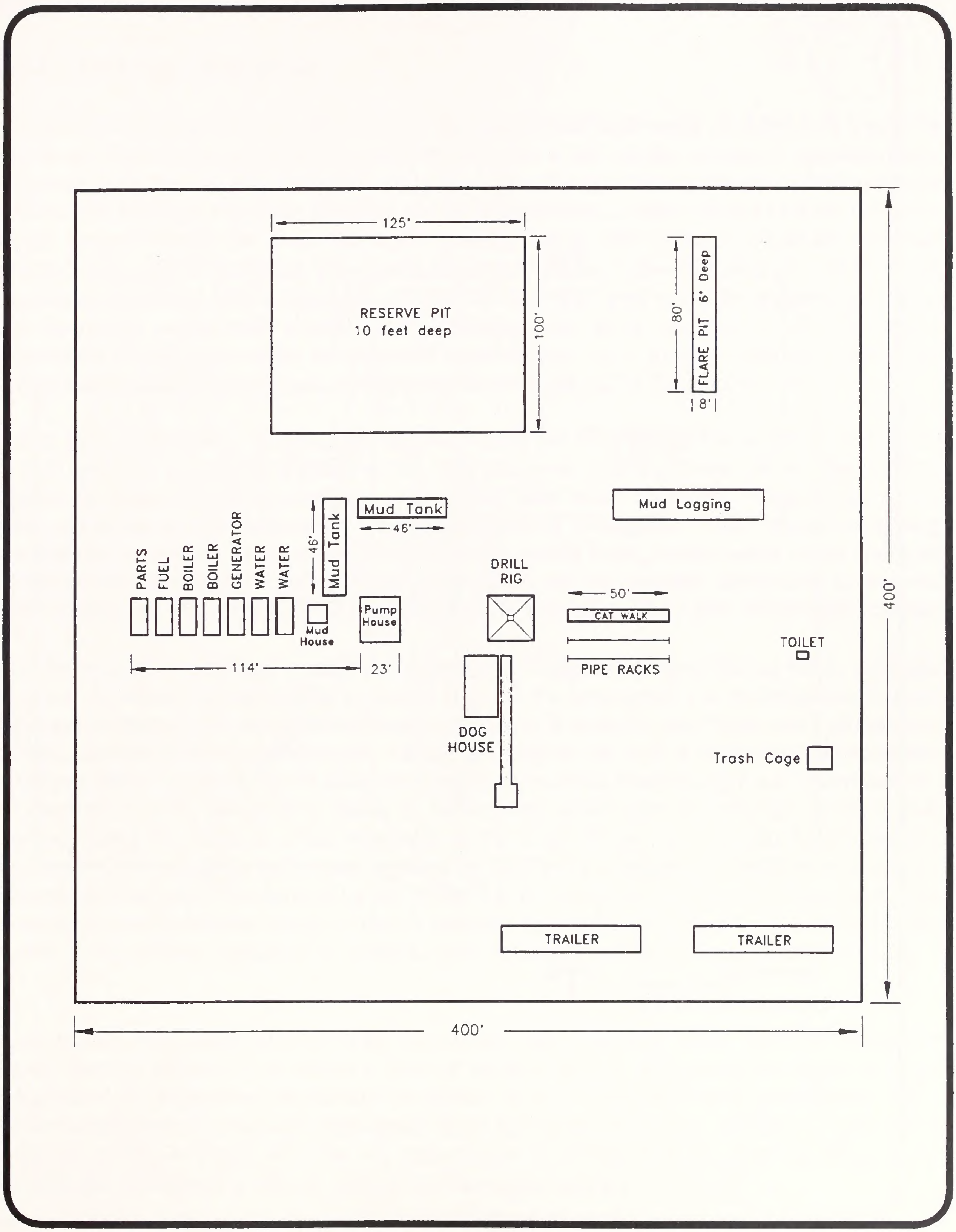


Exhibit 2-1. Typical Drawing of a Traditional Single-well Pad.

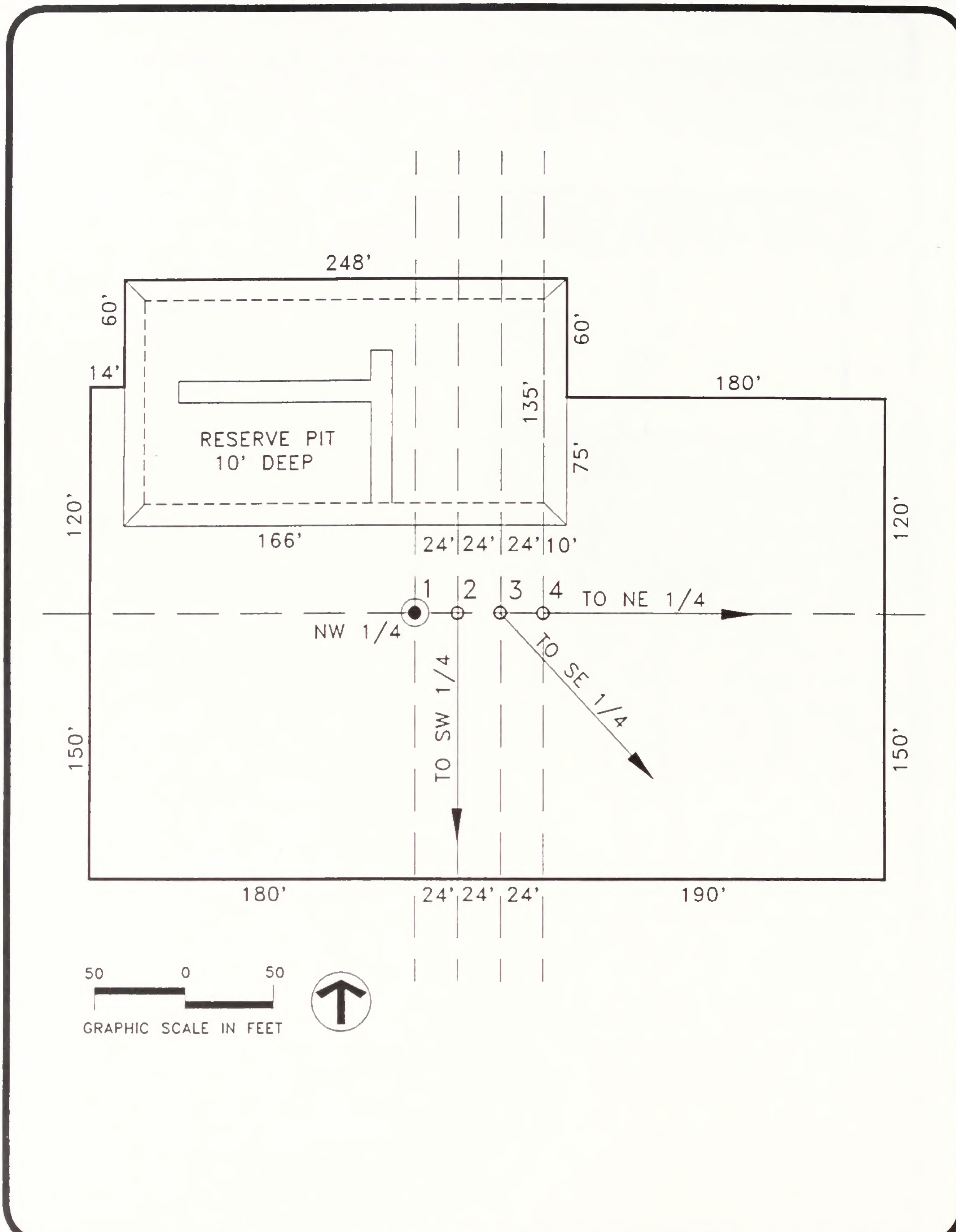


Exhibit 2-2. Typical Drawing of a Single Pad/Multi-well Facility.

2.3.2.2 Well Pad Construction

The traditional single-well pads (Exhibit 2-1) and single pad/multi-wells (Exhibit 2-2) would be constructed from native materials located at the site and would occupy an area of approximately 3.67 acres (400 feet by 400 feet) depending on terrain limitations at each individual well site location. The well pad would be designed so that construction materials would balance (i.e., cut-and-fill material would be about the same quantity) while attempting to minimize the total disturbed area. Actual well pad size would be shown on the individual well site APD. Total disturbance associated with construction of the 3.67-acre well pad would be approximately five acres including cut-and-fill slopes, topsoil storage, and other ancillary areas. Therefore, construction of drill pads under the proposed action would result in approximately 1,500 acres of disturbance (i.e., 300 drill pads, each disturbing approximately five acres).

Prior to pad construction, all available topsoil suitable for reclamation would be stripped from the well pad area and stored adjacent to the well pad at the site designated on the design plan. Cut-and-fill slopes would be designed in a manner that would allow for retention of topsoil during reclamation and subsequent re-establishment of vegetation. After topsoil stripping operations are complete, construction of the well pad would begin. Construction of the well pad and related facilities would usually require seven to ten days to complete, depending on site and terrain limitations. Construction practices would involve use of standard earth-moving equipment.

Other features of the well pad would be a reserve pit to temporarily store drilling fluids, cuttings, and water produced during drilling as well a flare pit for emergency and development flaring. Two types of reserve pits would be utilized in the GWA II analysis area. These are lined reserve pits and earthen (unlined) reserve pits. Lining the reserve pit with a reinforced impermeable membrane that is at least 12 to 16 mils thick, resistant to decay from sunlight and hydrocarbons, and compatible with the drilling fluids to be retained would prevent seepage. Reserve pits requiring lining are those in close proximity to the Green River or Colorado River drainage systems or other sensitive environments such as shallow groundwater, groundwater recharge areas, or "critical areas" (as defined by the WOGCC). Pits would also be lined in areas with high potential for communication between the pit contents and surface water or shallow groundwater or other types of water supplies. In addition, pits constructed in fill material would be lined.

In non-critical areas, and when a fresh water-based mud system is being used, an earthen or unlined reserve pit would be utilized. Use of earthen reserve pits would be approved after evaluation of the pit location for distance to surface waters, depth to useable groundwater, soils, and after evaluation of the fluids that would likely be retained in the pit. All reserve pits would be fenced within 24 hours after the rig substructure is moved from the drill site location to minimize the potential for loss of wildlife and domestic animals.

Site erosion and off-site sedimentation would be controlled by requiring operators to promptly revegetate sites and provide surface water drainage controls such as berms, sediment collection areas, diversion ditches, and erosion stops. Locations of these measures would be included in the design plan for the well site. Service trailers located on the well pad would be self-contained and would not require a septic system. Sewage would be hauled off-site to a State-approved disposal site.

In the event drilling is non-productive, all disturbed areas, including the well site and new access road, would be reclaimed to the landform that existed prior to construction. Reclamation and site stabilization techniques would be specified in the APD Surface Use Plan or the ROW Plan of Development (POD). Appendix B presents recommended practices for reclaiming disturbed areas associated with drill site, access road, pipeline, and facility construction. The actual measures used to reclaim a disturbed site would be developed based on Appendix B and on consultation with the BLM.

If drilling is productive, all access roads to the well site would remain in place for well servicing activities (e.g., maintenance, improvements, etc.). Partial reclamation would be completed on portions of the well pad and access road ROW when no longer needed. Exhibit 2-3 shows a typical well pad layout during production testing/completion. Production well facilities installed at the production well sites are shown in Exhibit 2-4.

2.3.2.3 Access Road Construction

The primary road access that would be utilized by the Operators is Interstate 80 (I-80), Wyoming Highway 789 heading south from I-80, and Sweetwater County Road 4-23 (Wamsutter-Dad Road), used in conjunction with the BLM-administered roads within the GWA II analysis area.

The BLM in Wyoming defines three classes of roads:

1. <u>Collector Roads</u>. These roads normally provide primary access to large blocks of land and connect with, or are extensions of, a public road system such as I-80 and WY Highway 789. The Sweetwater County 4-23 (Wamsutter-Dad) road is an example of a collector road. Collector roads receive a high volume of traffic and usually require application of the highest road standards used by the BLM. The design speed is 30 to 50 miles per hour (mph) and the subgrade width is a minimum of 28 feet (24 feet full-surfaced travelway).

2. <u>Local Roads</u>. These lower volume roads usually provide the internal access network within an oil/gas field. The design speed is 20 to 50 mph and the subgrade width is normally 24 feet (20 feet minimum full-surfaced travelway). Low volume roads in mountainous terrain may be single-lane roads with turnouts.

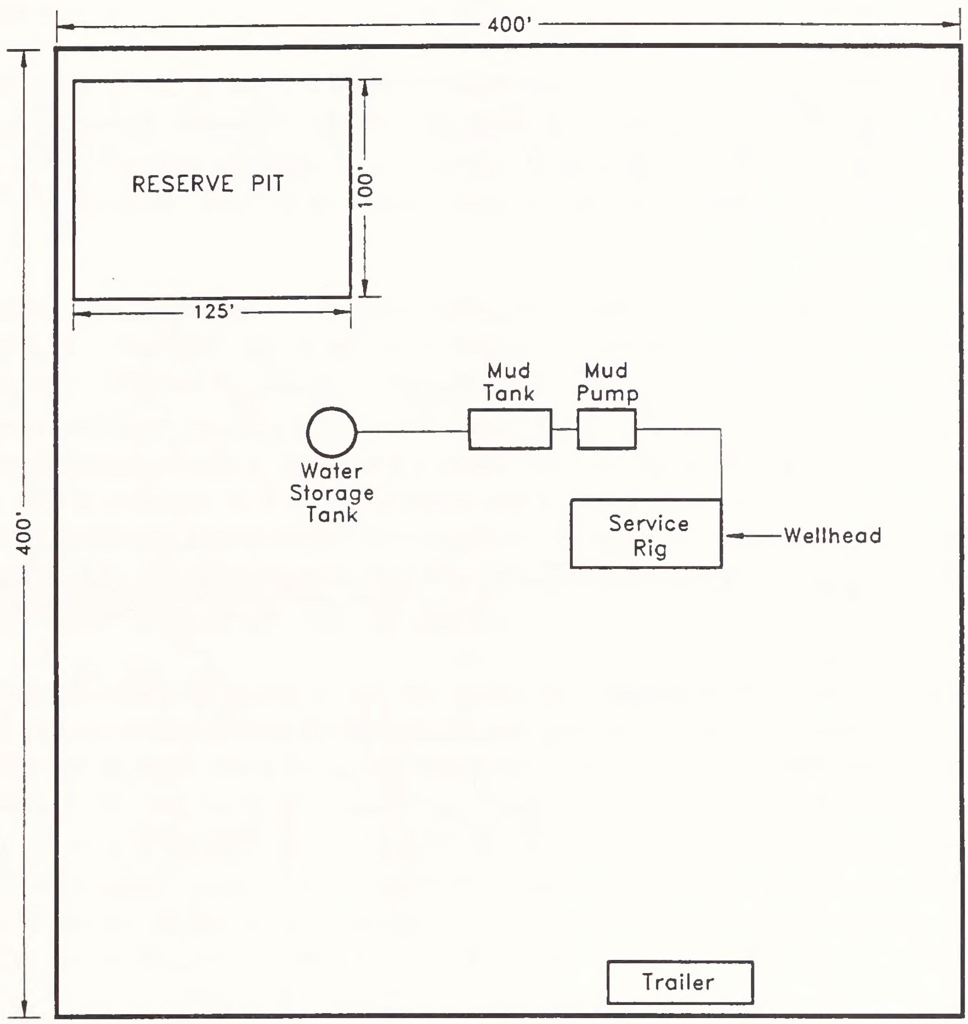


Exhibit 2-3. Typical Well Pad Diagram With Production Facilities.

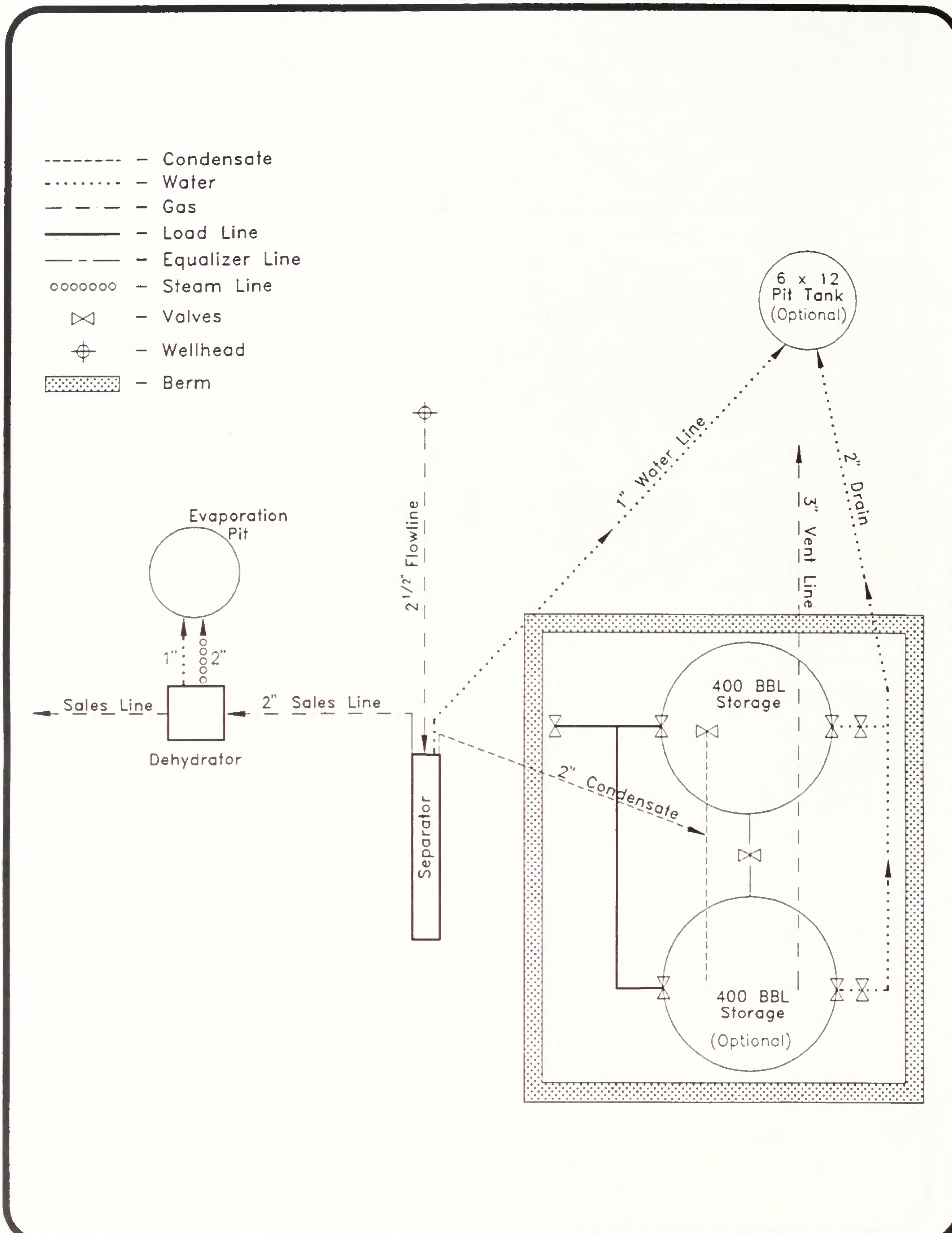


Exhibit 2-4. Production Well Facilities Installed at the Production Well Sites.

3. Resource Roads. These are normally spur roads that provide point access. Roads servicing individual oil/gas exploration and production locations usually fall within this classification. These roads have a design speed of 15 to 30 mph and are constructed to a minimum subgrade of 16 feet (12 feet minimum full-surfaced travelway) with intervisible turnouts for opposing traffic.

Access roads across public lands would be designed and constructed in accordance with BLM Manual 9113 standards, which sets forth procedures for oil and gas exploration and development of roads on public lands in accordance with access road design plans submitted by the Operators to the BLM for approval. Such road design plans would be included in the individual well site APD.

Design plans would locate roads to maximize transportation efficiency and minimize disturbances. The number and cumulative length of roads would be limited to decrease potential impacts by discouraging development of looped roads and by accessing wells from short resource roads off the local roads. All new access roads would be constructed for the specific purposes of natural gas field development. Surface disturbance would be contained within the road ROW. Surface disturbance would average 40 feet for resource roads and 48 feet for local access roads. Roads would be built, surfaced, and maintained to provide safe operating conditions at all times. Unless otherwise directed by the BLM, roads would be closed and reclaimed by the Operators when they are no longer required for production operations.

Following completion and approval of the permanent road design plans, the road would be construction staked on the ground in accordance with BLM Manual 9113 standards. Construction staking would be in place prior to any surface-disturbing activities. All permanent roads (i.e., those collector, local, and resource roads to be used by GWA II operators throughout the life of the project) to be constructed across public lands would be designed and staked under the direction of a licensed, professional engineer. Road construction would be monitored by a qualified professional engineer or qualified inspector, as deemed appropriate by the BLM. As indicated, the GWA II area already has a substantial road system in place. Taking this into consideration, each new well pad would require approximately 0.5 miles of new road. Assuming a disturbance width of 50 feet to include adjacent pipelines, approximately 3.03 acres would be disturbed for each new well pad, or 909 total acres. This, combined with approximately 5.0 acres of construction disturbance per well pad for a total of 1,500 acres would result in a total construction disturbance of 2,409 acres due to roads, pipelines, and drill sites. The seven-acre compressor station would add to this total, for a total of 2,416 acres. This would increase total disturbance in the GWA II analysis area by 0.7 percent. As discussed in Section 2.3.3.4, a large portion of this total disturbance would be reclaimed during the production phase.

Construction equipment and techniques utilized by the Operators would be standard (e.g., crown-and-ditch method.) A typical roadway cross-section with width specifications for use in the GWA

II analysis area is shown in Exhibit 2-5. All roads would be constructed with adequate drainage and erosion control structures (e.g., relief culverts, drainage culverts, wing ditches, rip-rap). The Operators propose to gravel the local roads out to the well sites.

Resource roads to well sites in producing fields would be graveled immediately following construction. Resource roads to exploratory well sites may or may not be gravel surfaced prior to drilling operations depending on the native soil material, steepness of the road grade, and on the time of year in which the well is drilled. Surfacing requirements would be determined by the BLM or landowner. Surfacing materials and gravel would be obtained from neighboring Operators' fee sections that have existing, operational gravel pits. Roads would be built and maintained to provide year-round access.

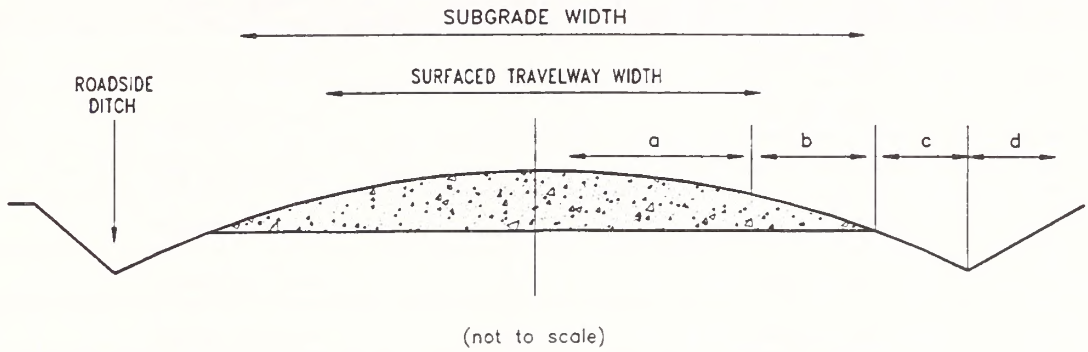
Respreading of windrowed vegetation to the sideslopes of the newly constructed access roads and revegetation would begin as soon as the well proves productive and soil conditions permit. The resource road to an unproductive well site would be reclaimed upon abandonment of the well using stockpiled topsoil and a BLM-approved seed mixture and following the recommendations presented in Appendix B, as required by the BLM.

A road maintenance agreement for the Echo Springs and Standard Draw fields has been developed between the primary operators within these fields. This agreement addresses the combined use of roads and road maintenance responsibilities within these fields. The agreement was also developed to identify roads no longer needed for oil and gas exploration and production activities, and to coordinate their subsequent closure and reclamation. Estimated traffic requirements for drilling operations, completion operations, and production operations are shown in Tables 2-1, 2-2, and 2-3.

2.3.2.4 Drilling Operations

Following construction of the pad and access road, the drill rig would be moved to the pad and erected on site. The Operators anticipate beginning the Echo Springs/Standard Draw infill drilling program with three drilling rigs, and increasing to eight rigs after the first month of drilling. The number of drilling rigs constantly operating in the GWA II analysis area would drop back to three once the Echo Springs/Standard Draw infill program was completed.

Each drilling operation would require transport of approximately 60 truckloads of drilling-related equipment and materials to facilitate the drilling operation. This figure includes transportation of the drill rig, drill pipe, and drilling compounds, casing, support equipment, etc. but does not include the truck traffic required for resupplying the operation (e.g., fuel). Additional traffic would be variable, depending on the phases of the drilling operation, but should not include more than two or three vehicles per day per well site throughout the drilling operation.



	MINIMUM SUBGRADE WIDTH (ft)	MINIMUM SURFACED TRAVELWAY WIDTH (ft)	a (ft)	b (ft)	c (ft)	d (ft)	APPROXIMATE DISTURBANCE WIDTH (ft)	TOTAL ROW WIDTH (ft)	DESIGN SPEED (mph)
RESOURCE ROAD	16	12	6	2	4	8	40	50	15-30
LOCAL ROAD	24	20	10	2	4	8	48	55	20-50
COLLECTOR ROAD	28	24	12	2	4	8	52	60	30-50

DIAGRAM OF TYPICAL TURNOUTS ON RESOURCE ROADS (PLAN VIEW)

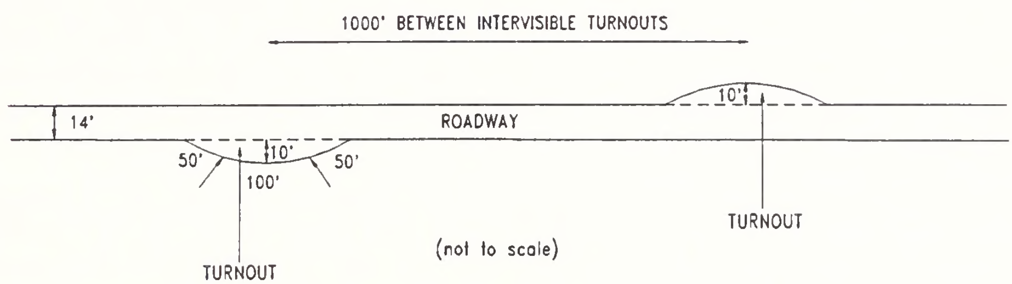


Exhibit 2-5. Typical Roadway Cross-Section with Width Specifications.

Table 2-1. Estimated Traffic Requirements for Drilling Operators (20 Days/Well).

Type of Traffic	Trip Frequency
Rig Supervisor	2/day
Rig Crews	3/day
Hauling Trucks - six Types	2/well
Gravel Truck	1/well
Mud Logger	2/day
Mud Engineer	1/day
Loggers - Logging	4/well
Fuel Trucks	1/day
Mud Trucks	1/week
Mechanics for Rig	1/week
Drill Bit Deliveries	2/week

Total rig-up activities and installation of ancillary facilities would take three days to complete. The approximate planned drilling depth is 10,500 feet at each well site. Each well is expected to take approximately 20 days to drill barring any major drilling problems. Appendix C, the Master Surface Use and Operating Plan, provides specific information regarding drilling operations within the GWA II analysis area.

To date, most of the gas wells in the analysis area have been drilled vertically. Vertical rotary drilling is a highly efficient process for drilling and completing traditional oil and gas wells. Directional drilling has been introduced in the GWA II analysis area recently and is being selectively used to facilitate the need to drill wellbores in a non-vertical direction. Special drilling tools and procedures are used to change the direction of the wellbore from vertical to directional and possibly horizontally in order to penetrate targets that cannot be reached by regular vertical methods.

Directional and horizontal drilling are high-risk drilling operations compared to vertical drilling. Efficient drilling programs must be designed and implemented carefully in order to successfully complete the well. Use of these techniques are increasing with development of new drilling tools and techniques. Experimental programs are currently being implemented in the GWA II analysis area by the Operators to explore the use of new techniques and efficiency of new tool design. A typical directional drilling schematic showing directional drilling profile well path, target, and limits is shown in Exhibit 2-6.

Table 2-2. Estimated Traffic Requirements for Completion Operations (30 Days/Well).

Type of Traffic	Trip Frequency
Completion Foreman	2/day
Completion Crew	2/day
Completion Rig Equipment Truck	4/well
Casing Crews	4/well
Cementing Crews	4/well
Casing Haulers	6/well
Cement Truck	6/well
Cementing Pump Truck	2/well
Welders	6/well
Service Tools Trucking	2/week
Tubing Truck	2/well
Logging Crews	2/week
Fracing Crews	2/day
Fracing Supply Truck	12/well
Supply Trucks	4/week

Table 2-3. Estimated Traffic Requirements for Production Operations.

Type of Traffic	Trip Frequency
Production Foreman	2/week
Pumper	daily
Oil Hauler	2/month

Directional drilling in the GWA II analysis area is being utilized in connection with single pad/multi-well production operations. The advantages of successfully drilling multiple directional wells from a single pad include one area of disturbance with common access routes, separation facilities, gathering system, storage facilities, and one-stop well servicing.

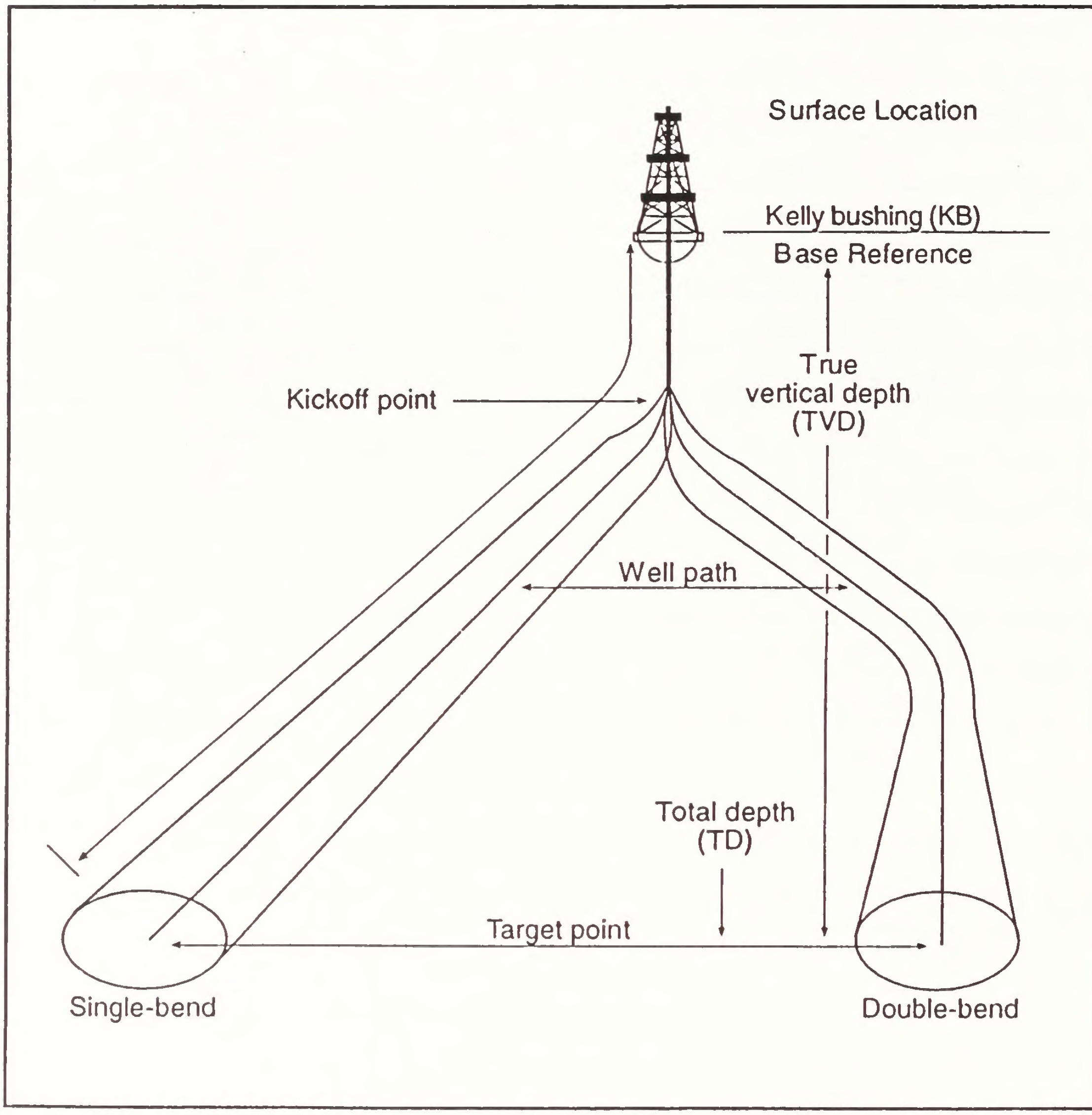


Exhibit 2-6. Directional Drilling Profile Well Path, Target, and Limits.

Horizontal drilling is being utilized within the GWA II analysis area to improve the productivity of existing, marginal wells. Existing, uneconomical vertical wellbores are being re-entered and drilled horizontally in an attempt to increase the productivity of the well sufficiently enough to develop marginal reserves. Horizontal drilling is being applied to existing cased, vertical, and directional wells with larger diameter casing and favorable wellbore conditions.

Horizontal drilling involves drilling a curved section from the bottom of a vertical hole, followed by drilling horizontally into the productive formation. Long horizontal sections increase oil and gas flows. Exhibit 2-7 shows a cross-section view of horizontal drilling. A schematic showing drilling and completion phases of a horizontal well is shown in Exhibit 2-8.

Successful efforts by the Operators would likely encourage further development of low permeability formations with known reserves that are common to the GWA II. Use of existing vertical and directional cased holes would revitalize the use of existing abandoned locations and facilities. These re-entered wells would also utilize the existing well spacing requirements, thus minimizing and/or preventing new construction or disturbance.

Water for drilling and service trailer use would be obtained from State of Wyoming approved sources near the well site or a water well drilled on the well pad. There are several water wells within the GWA II analysis area that could be used for drilling and well completion purposes. Several water wells were drilled in the Echo Springs Field during the 1992 infill drilling program.

2.3.2.5 Estimated Employment Requirements

The estimated employment requirements for the drilling, completion/testing, and producing well services are shown in Tables 2-4, 2-5, and 2-6. During the drilling process, approximately 30 personnel would be involved. Completion and testing of each well could involve 32 personnel. The production phase could involve 13 personnel.

2.3.3. Production Phase

2.3.3.1 Pipeline Construction

There are several gas pipelines currently in operation within the GWA II analysis area. Williams Field Services (Williams) and Colorado Interstate Gas (CIG) primarily own and operate the existing gas pipeline network. The Operators plan to use the existing network of gas-gathering pipelines to transport natural gas.

New gathering lines would become part of the gas-gathering system currently managed by Williams Field Services and Colorado Interstate Gas. New gas pipelines would be three or four inches in diameter. The distance from a new well to the existing gathering system would be between 0.5 and 1.5 miles. The maximum width of the pipeline ROW and disturbance area would

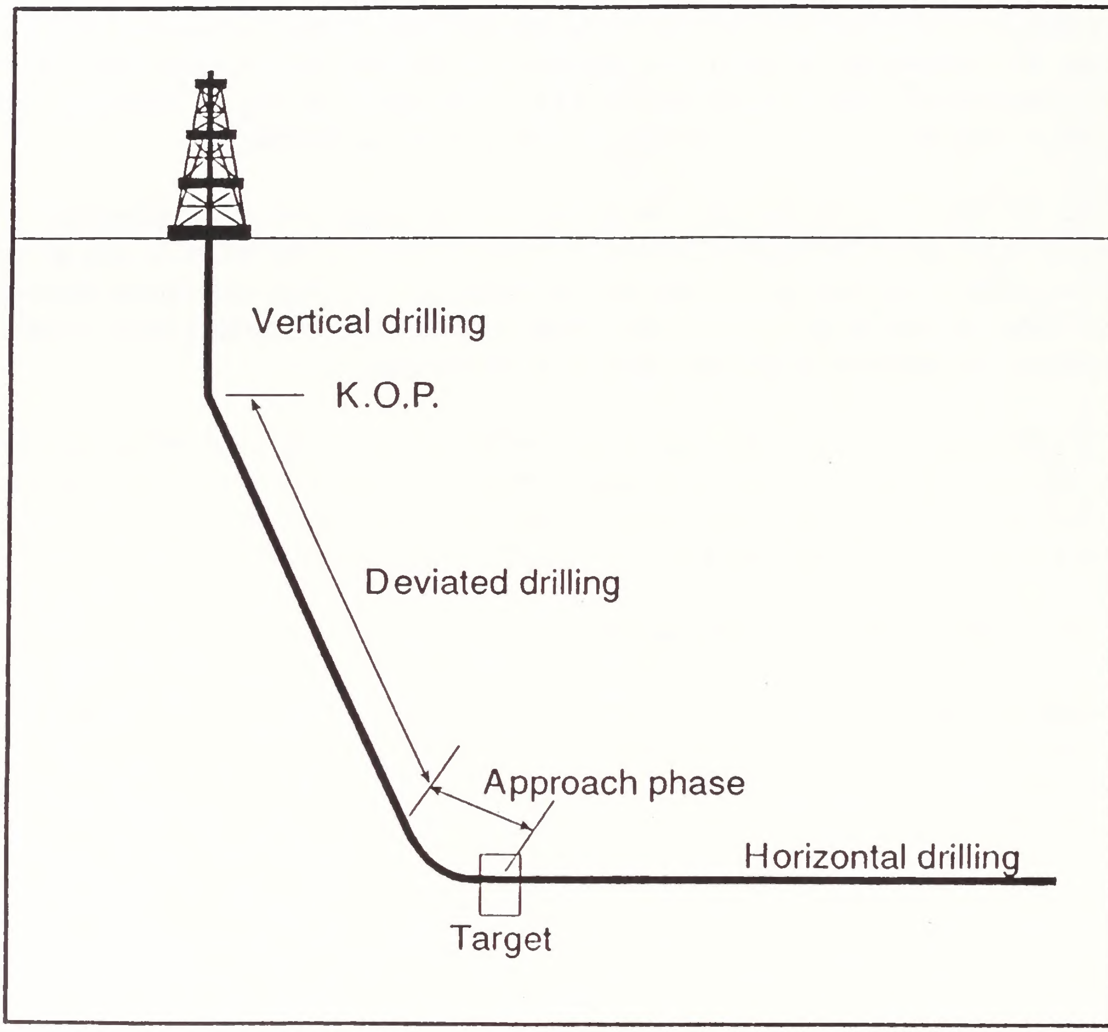


Exhibit 2-7. Cross-sectional View of Horizontal Drilling.

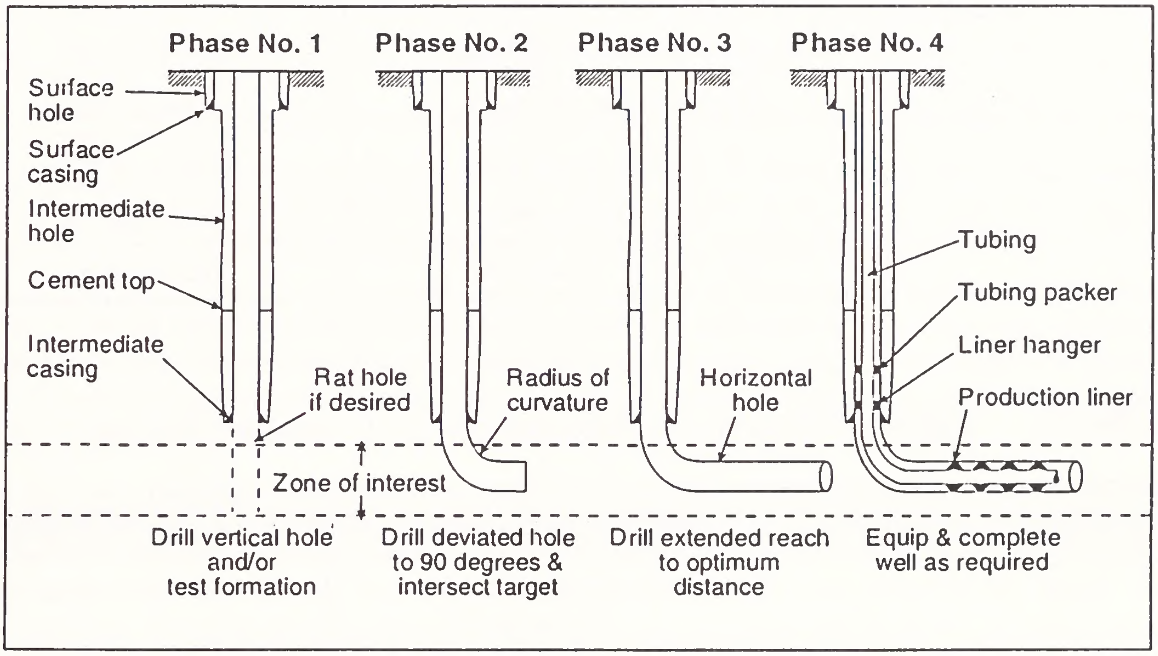


Exhibit 2-8. Schematic Showing Drilling and Completion Phases of a Horizontal Well.

Table 2-4. Estimated Employment Requirements for Drilling.

Number of Personnel	Employment Category	Type of Commute
3	Construction Crew - Road & Location (5-7 days/well)	Local daily Commute
15	Drilling Rig Setup and Transport (4 days/well)	Local daily Commute
1	Drilling Engineer	Once a month
2	Drilling Foreman (20 days/well)	Reside locally
1	Mud Engineer (7 days/well)	Resides on location
1	Tool Pusher (20 days/well)	Reside on site
2	Service Companies	Daily commute
5	Rig Crew (3 crews of 5)	Daily commute

Table 2-5. Estimated Employment Requirements for Completion/Testing.

Number of Personnel	Employment Category	Type of Commute
1	Completion Foreman (30 days/well)	Daily commute
5	Casing Crew	Local commute
1	Cementing Crew	Resides locally
1	Tool Pusher (30 days/well)	Daily commute
1	Rig Crew	Daily commute
8-15	Frac Crew	Local commute
2	Service Company	Resides locally

Table 2-6. Estimated Employment Requirements for Producing Well Services.

Number of Personnel	Employment Category	Type of Commute
1	Production Foreman	Resides locally
3	Rig Crew	Resides locally
3	Service Crew	Resides locally
4	Roustabouts	Resides locally
1	Pumper	Resides locally
1	Haulers	Resides locally

be 50 feet. The right-of-way would be placed adjacent to existing pipelines or roads where possible. A typical schematic of pipeline installation procedures is shown in Exhibit 2-9. Exhibit 2-10 shows a schematic of pipeline construction away from existing roads.

Given the existing high level of pipeline density and the expectation that most new pipelines would be constructed within the new or existing road disturbance zone, it is assumed that the 909 acres of disturbance assessed for road construction also includes any minor additional disturbance caused by pipeline construction.

The actual pipeline location would be surveyed and staked prior to starting any construction activities. The Operators or the pipeline construction company would submit engineered design plans for pipeline(s) planned on slopes 25 percent or greater when required by the BLM. The pipeline corridor would be cleared of heavy brush prior to any activities; however, in some areas, it may be feasible to crush the brush and woody vegetation in place. Stripping of topsoil from the pipeline corridor would be completed in those areas having adequate topsoil for reclamation. Similarly, on relatively level areas with deep soils, pipeline construction could be effectively accomplished without disturbing the total 50-foot wide pipeline ROW by leaving vegetation and topsoil in place.

Pipeline construction would occur in a planned sequence of operations common to natural gas pipeline installation specifications and would take place along a corridor of continuous activity. All pipeline installation work would be completed by a contractor working under supervision of the designated operator. Construction activities would be confined to the 50-foot-wide ROW.

The pipeline trench would be excavated mechanically with trenching equipment such as a backhoe or auger. The width of the trench would be 18 to 20 inches, depending on pipe diameter. The trench would be constructed to a minimum depth of four feet. Pipe-laying activities would include pipe stringing, bending, welding, coating, lowering of pipeline sections, and backfilling. Subsoil would be backfilled into the trench over the pipe. Site regrading would occur where

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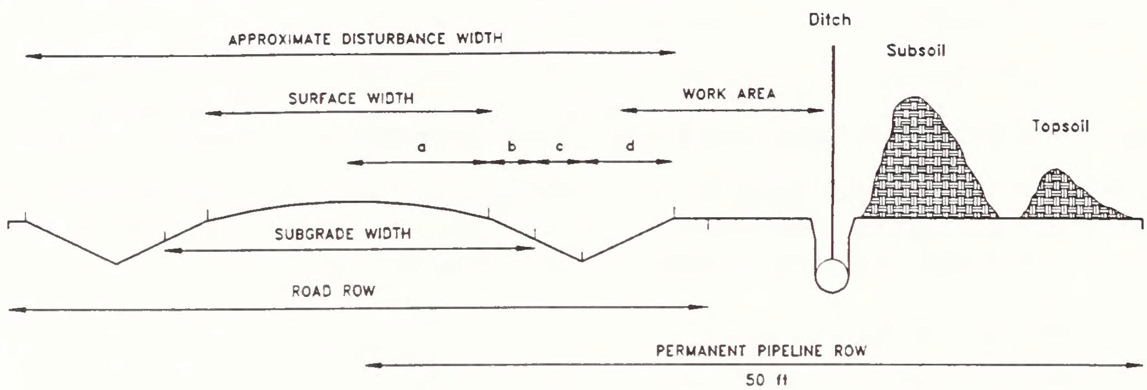

	MINIMUM SUBGRADE WIDTH (ft)	MINIMUM SURFACED TRAVELWAY WIDTH (ft)	a (ft)	b (ft)	c (ft)	d (ft)	APPROXIMATE DISTURBANCE WIDTH (ft)	TOTAL ROW WIDTH (ft)	DESIGN SPEED (mph)
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COLLECTOR ROAD	28	24	12	2	4	8	52	60	30–50

Exhibit 2-9. Typical Schematic of Pipeline Installation Alongside a Road.

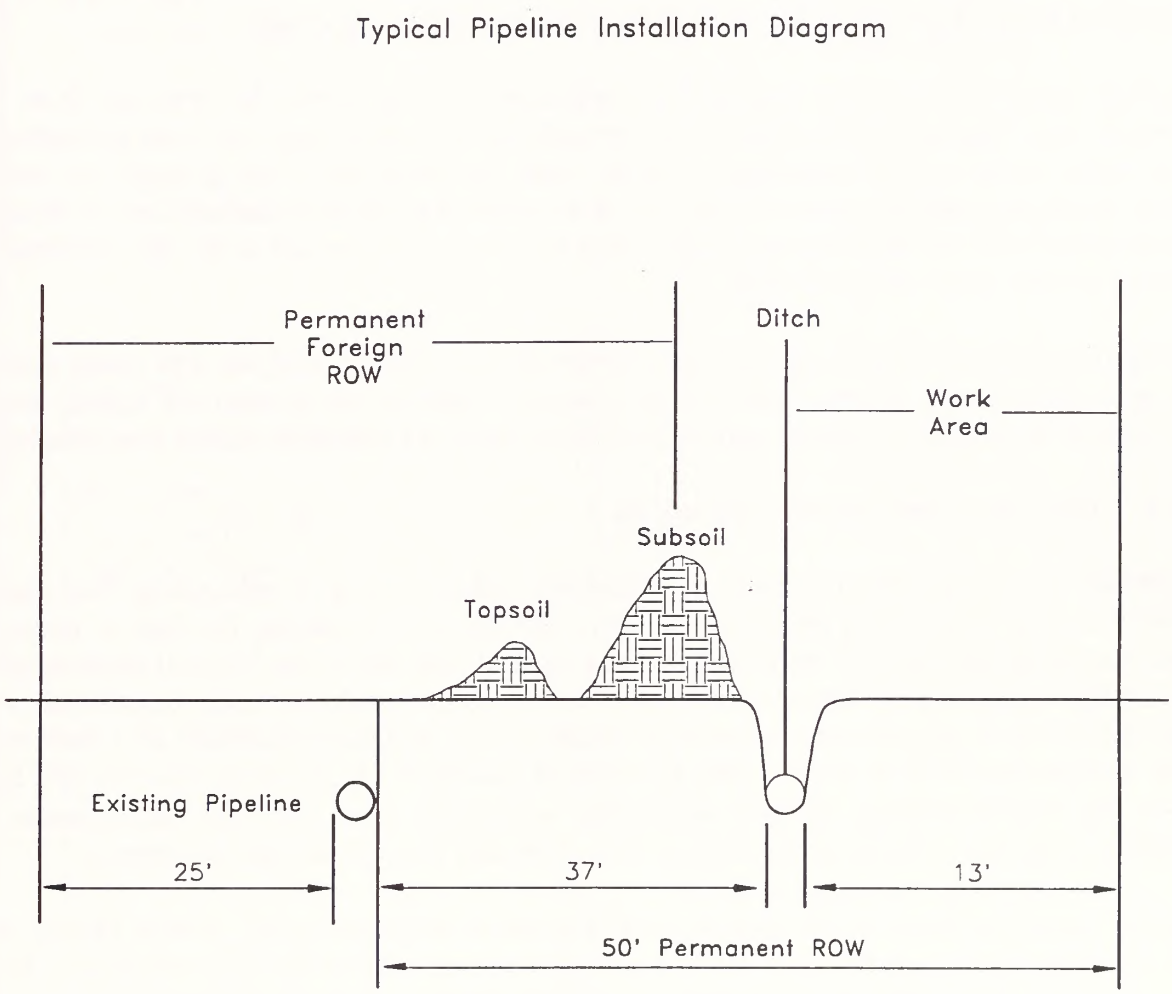

Exhibit 2-10. Typical Schematic of Pipeline Installation.

necessary. Reclamation of the pipeline route would occur as authorized by the BLM.
The newly-constructed pipelines would be tested to prove structural soundness. The method used would be hydrostatic testing, which consists of filling the pipeline with water, pressuring the pipeline to the designated test pressure (which exceeds operating pressure), and maintaining that pressure for a specified period of time. If any rupture or leaks occur, they would be located and repaired and the test process repeated until completely successful. The line would then be de-watered and dried to prepare it for final tie-in to the gas gathering system.

Necessary water appropriation permits for hydrostatic testing would be obtained from the Wyoming State Engineer's Office (SEO). Water would be taken from approved local groundwater source wells. After testing operations are completed, the water would be pumped into water-hauling trucks and transported to drilling locations within the GWA II analysis area to be used in conjunction with the drilling operations. This re-use of water would avoid the unnecessary discharge of test water on the ground.

Water produced from oil and gas drilling activities in the GWA II analysis area could also be used to hydrostatically test new sections of pipeline. Produced water used for testing would subsequently be hauled to disposal wells in the GWA II analysis area after testing was completed.

2.3.3.2 Completion and Testing Operations

Completion of well operations involves the placement and cementing of well casing. Well casing involves running steel casing pipe into the open borehole and cementing the pipe in place. A typical completed (cased) well bore diagram for a vertical well within the GWA II analysis area is shown in Exhibit 2-11. A typical completed well bore diagram for a deviated (directional) well within the GWA II analysis area is shown in Exhibit 2-12. A typical schematic of a horizontal drilled well in the GWA II analysis area is shown in Exhibit 2-13. A casing prevents drill hole cave-in and aquifer mixing, confines production to the well bore, and provides a means of controlling pressure to facilitate installation of surface and subsurface well equipment.

A typical cased wellbore in the analysis area consists of conductor pipe, surface casing, and production casing. Surface casing is set deep enough and cemented to the surface to protect fresh water aquifers. This surface casing is set at the start of drilling operations. Production casing and cementing are set to prevent gas, oil, condensate, or water from migrating from formation to formation and to isolate producing zones. Setting and cementing of production casing provides separation and isolation from abnormally pressured zones, usable water zones, and other mineral deposits. The well casing would then be perforated in the productive formation (the Mesaverde Group) to allow the flow of hydrocarbons to the surface. The typical production equipment layout is shown in Exhibit 2-14. Approximately 2,500 barrels of water would be needed in the completing and testing operations per well. Most completions in the GWA II analysis area use

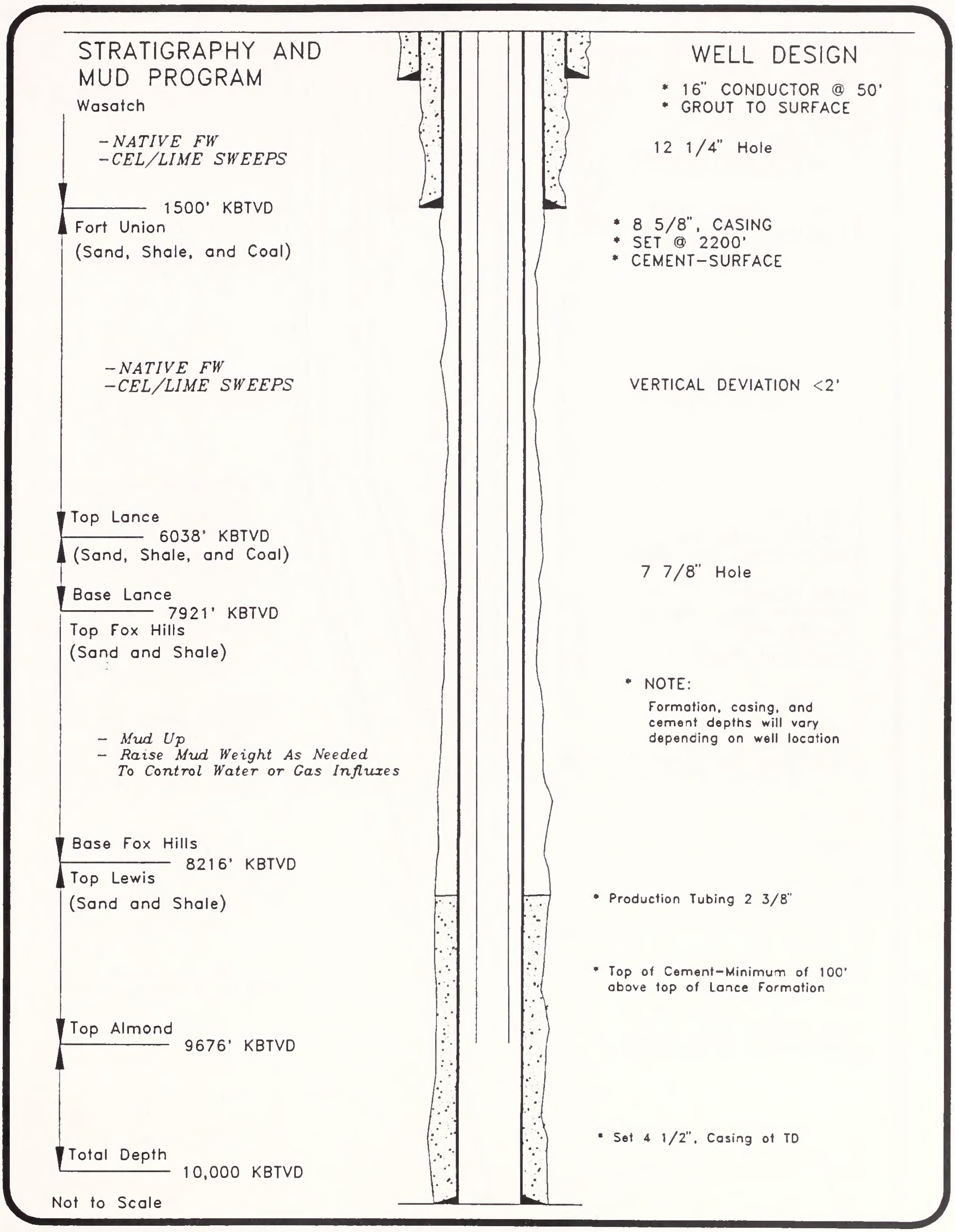

Exhibit 2-11. Typical Completed Wellbore Diagram for a Vertical Well.

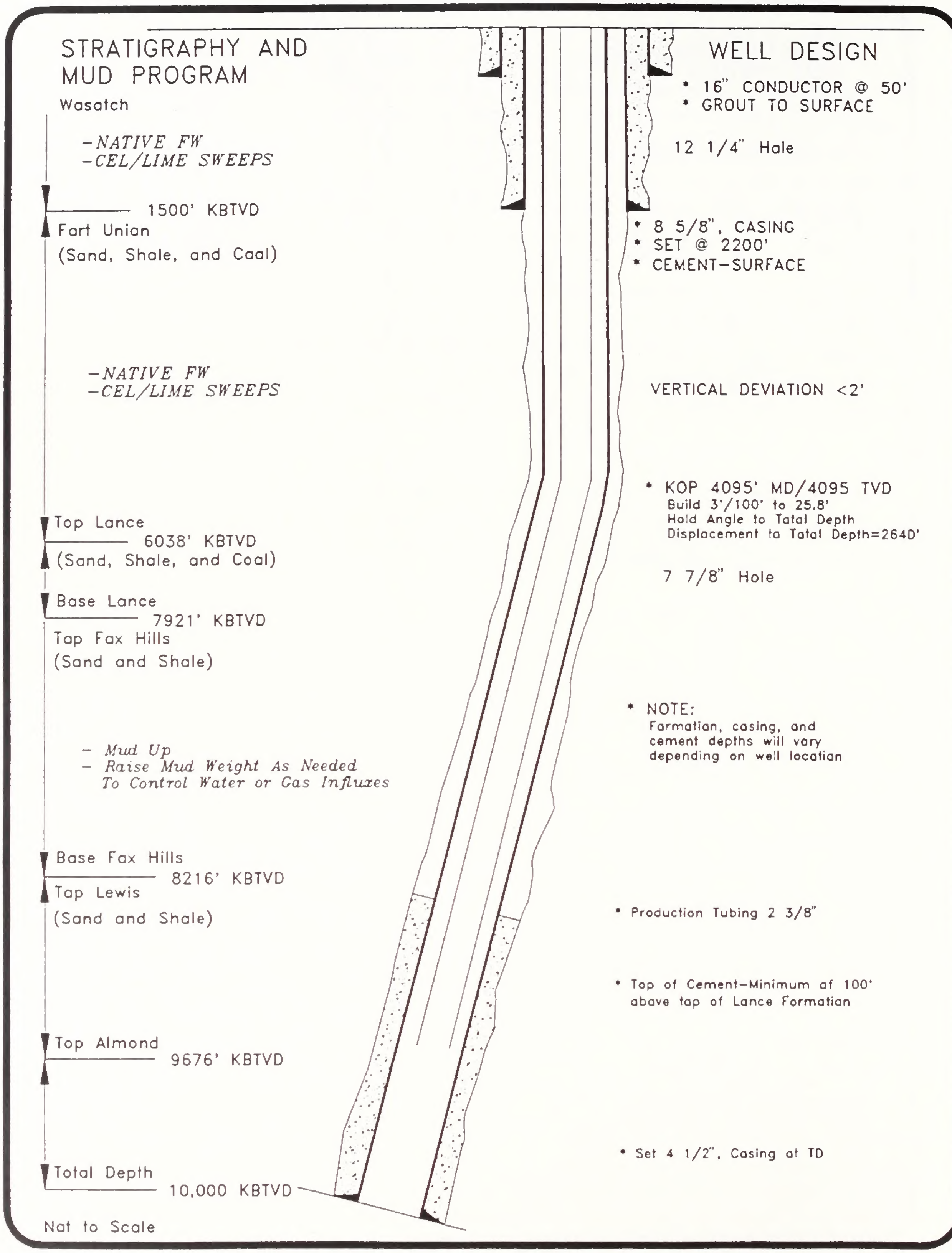

Exhibit 2-12. Typical Completed Wellbore Diagram for a Deviated (Directional) Well.

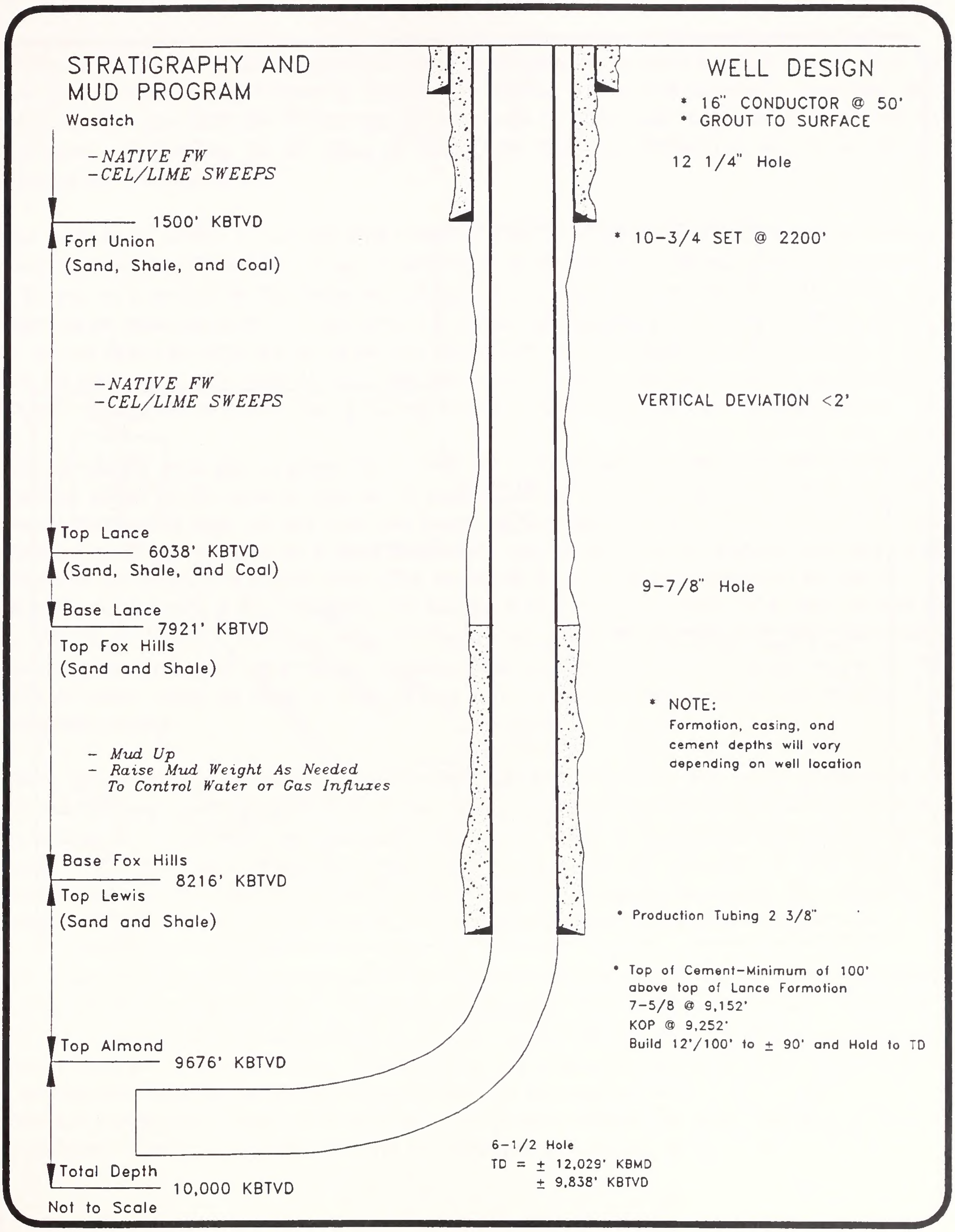

Exhibit 2-13. Typical Completed Wellbore Diagram for a Horizontal Well.

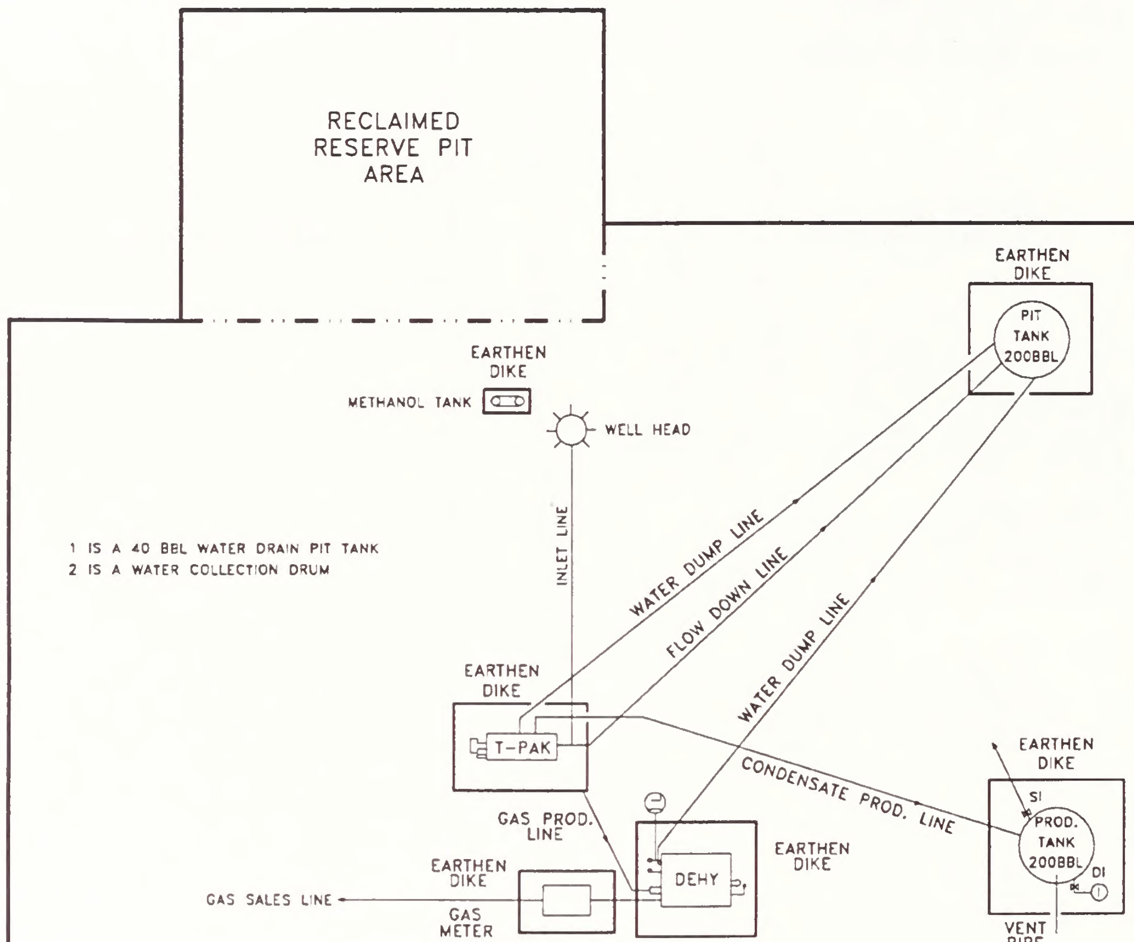

Exhibit 2-14. Typical Production Equipment Layout.

a string of tubing that is inserted in the casing to the top of the perforated productive zone to allow gas, condensate, and water to flow to the surface where it is collected, measured, and contained. The gas from the Mesaverde Group would be estimated and flared through testing procedures. Depending on the rates of these flow tests, the formations would be further evaluated for stimulation.

Most wells in the GWA II analysis area routinely need to be hydraulically fractured to increase flow rates from the Mesaverde Group. Fracturing of producing geologic units (fracing) increases the formation's production capability and stimulates gas flow. Carbon dioxide (CO_2), fluids, and proppants are pumped under pressure down the wellbore and into the producing perforations. The pressurized fluids are returned to the surface where they are contained in a completion pit or frac tanks on location. For the next 15 days, the well would be evaluated and tested for performance. Gas and condensate produced during testing would be flared into the flare pit on location.

Water produced with gas is generally considered to be condensed water vapor of low total dissolved solids (TDS) content. Estimated volumes based on Petroleum Information, Inc. (PI) reported production data are less than one barrel of water per day (BWPD) per well. Disposal of water would be by means of a lined evaporation pit, pit tank, or the disposal well approved for use in the GWA II analysis area. (The saltwater disposal facility approved for use in the GWA II analysis area is the Champlin 337 Amoco E No. 1 well operated by Amoco located in the SW1/4 of Section 17, Township 19 North, Range 93 West.) As indicated previously, depending on timing of availability, quantity, and quality of produced water, some of the produced water could be used in well drilling and completion, and pipeline construction and hydrostatic testing.

Flaring of gas during completion operations would occur 1) after the initial perforation of Almond Sands, if productive; and 2) during flowback operations following hydraulic fracture stimulation. Burnable products associated with flaring would be hydrocarbon gases and minor amounts of condensate. Incomplete combustion products (minor amounts of CO, NO_x) are possible. Anticipated duration of flaring is expected to be four to five days. The purpose of flaring is to determine the magnitude of flow and presence of combustible hydrocarbons.

In the event the well proves unproductive and the decision is made to abandon it, the well would be plugged prior to abandonment. Abandonment plugging consists of setting cement plugs in the wellbore at specified intervals according to state and federal regulations. These cement plugs would isolate and/or protect water, hydrocarbons, and other valuable deposits of other minerals by sealing off fluids in the formations penetrated by the well so that fluid from one formation would not escape into another formation or to the ground surface. The cementing process closes the wellbore in such a way as to prevent the migration of oil, gas, or salt water.

2.3.3.3 Production Estimates

The expected natural gas production performances for the infill wells located in the Echo Springs and Standard Draw Fields are as follows:

- Initial Production Rate - 1.5 million cubic feet per day (MMCFD) + 38 barrels of condensate per day (BCPD)

- Expected Reserves - 3.4 billion cubic feet (bcf) + 85 thousand barrels of condensate (MBC)

Table 2-7 presents typical produced gas composition within the Echo Springs and Standard Draw fields.

2.3.3.4 Production Operations

Production operations within the analysis area would likely occur on a year-long basis or as ground and site conditions permit. Production operations would require use and maintenance of access roads on an annual basis. Maintenance during the summer and early fall months would be typical of graveled road maintenance operations in the area. Winter maintenance would include blading and blowing snow from the access road as necessary.

Each individual natural gas production site would be approximately 2.1 acres (300 feet by 300 feet). Thus the balance of the approximate five-acre disturbance area associated with construction of a drill pad (including cut-and-fill slopes, reserve pit, ancillary facilities, etc.) would be reclaimed for the production phase (i.e., 2.9 acres). Therefore, total disturbance associated with well site construction would be reduced from 1,500 acres to 630 acres through reclamation of the 2.9 acres of disturbance area. Similarly, a large portion of the disturbed 50-foot wide road/pipeline ROW would be reclaimed. Approximately 10 feet of the 50-foot wide ROW would be reclaimed thereby reducing total disturbance from 909 acres to 727 acres. No part of the seven-acre compressor station would be reclaimed. Therefore, total disturbance would be reduced from 2,416 acres to 1,364 acres or from 0.7 percent to 0.4 percent of the GWA II analysis area during the production phase.

A central production facility would not be necessary since each producing well would be accommodated by its own production facility. Electricity would not be required to operate the well or facilities. The production system would be powered by a series of solar cells and batteries. All wells may eventually be automated, (i.e., measurements of gas and condensate would be obtained through an electronic gas measurement system). Condensate may be measured through electronic tank level indicators.

Table 2-7. Typical Composition of Produced Gas in the Echo Springs and Standard Draw Fields.

Gas	Mole Percent	Gas	Mole Percent
Carbon dioxide	3.241	Isopentane	0.223
Nitrogen	0.249	Pentane	0.166
Oxygen	0.000	Hexanes	0.175
Methane	81.539	Heptanes	0.080
Ethane	8.418	Octanes	0.080
Propane	4.164	Nonanes	0.005
Isobutane	0.867	Decanes Plus	0.002
Butane	0.842		

Maintenance and Workover Operations. All wells, pipelines, and associated ancillary production facilities such as water wells and water treatment and disposal facilities would be operated in a safe manner by GWA II operators as set forth by standard industry operating procedures. Routine maintenance of producing wells would be necessary to maximize performance and detect potential difficulties with gas production operations. Each well location would be visited about every other day to ensure operations are proceeding in an efficient and safe manner. The visits would include checking separators, gauges, valves, fittings, and on-site storage of produced water and condensates. Routine on-site equipment maintenance would also be performed as necessary. Additionally, all roads and well locations would be regularly inspected and maintained to minimize erosion and assure safe operating conditions.

Well workovers are required to ensure well bore integrity and to maximize gas flows by cleaning out the well bore. This work is completed utilizing a rig similar to that used for completion operations. Workovers and other routine well bore maintenance work would occur once every 10 years for each well and would take an average of 10 days to complete.

Ancillary Facilities. The proposed action and alternatives would utilize existing ancillary facilities within the GWA II analysis area. Existing powerlines, water treatment and disposal facilities, water wells, and compression facilities would be used to the maximum extent possible. Increased gas supply resulting from the proposed action and alternatives would require some expansion of existing compressor/treatment stations. Currently, compressor/treatment facilities within the GWA II analysis area are owned and operated by Williams. With the proposed increase in natural gas production, Williams plans to increase the capacity of the existing gas compression facility in the GWA II analysis area, and construct and operate a new compression facility starting in March, 1995. The new facility will occupy an area approximately seven acres in size and would be located on fee surface.

Geophysical Operations. Seismic data acquisition from previous seismic operations would be utilized by GWA II operators for the expanded drilling and production operations described under the proposed action and alternatives. Additional geophysical operations may be necessary in the GWA II analysis area as drilling activity increases into areas of marginal or unknown gas reserves. Any geophysical operations conducted as a result of the GWA II project would be implemented using procedures specified in the BLM's Great Divide Resource Area RMP (USDI-BLM 1990a) after receipt of BLM and/or WOGCC approval. The majority of seismic data acquisition would likely be large scale 3-D surveys. Most data acquisition would be gathered using vibrators, primarily for economic and environmental reasons. Shot-hole dynamite may be used if field conditions, other limitations, or new acquisition criteria require such an operation.

2.3.3.5 Site Restoration and Abandonment

The Operators propose to completely reclaim all disturbed areas not needed for production activities. Reclamation would generally include: 1) complete cleanup of the disturbed areas (drill sites, access roads, etc.); 2) restoration of the disturbed areas to the ground contour that existed prior to construction; 3) replacement of topsoil over all disturbed areas; 4) ripping of disturbed areas to a depth of 12 to 18 inches; and 5) seeding of reclaimed areas with the seed mixture prescribed in the Surface Use Plan or Plan of Development for the proposed action. Specific reclamation recommendations for use with the natural gas drilling and production operations within the GWA II analysis area are described in Appendix B. The specific reclamation/relocation measures applied to a particular facility would be developed in consultation with the BLM following the measures described in Appendix B.

2.3.4 Project-Wide Mitigation Measures

The Operators within the analysis area propose to implement the following mitigation measures and procedures on public lands to avoid or mitigate resource or other land use impacts. These mitigation measures and design features may be waived on a case-by-case basis when deemed appropriate by the BLM. This determination would be made only after a thorough, site-specific analysis determined that the resource or land use for which the measure was put in place would not be significantly impacted. Also, the Operators will utilize an environmental compliance coordinator to ensure compliance with the mitigation measures stipulated in the EIS, the individual rights-of-ways, and well site APDs.

2.3.4.1 Preconstruction Planning and Design Measures

Measure 1: The Operators and BLM will make on-site interdisciplinary team (IDT) inspections of each proposed and staked facility site (e.g., well sites, roads, pipelines, etc.), new access road, access road reconstruction, and pipeline alignment projects so that site-specific recommendations and mitigation measures can be developed.

Measure 2: The operators will submit for approval a transportation plan for existing roads and new access roads within the GWA II analysis area planned for use as a part of field development activities. Contents of the transportation plan will be coordinated with the BLM and will specify road work needed to accommodate field development activities. The transportation plan will be completed within six months of project approval. Road construction and maintenance operations conducted by GWA II operators during transportation plan preparation will be in accordance with BLM Manual 9113 standards.

Measure 3: The Operators will prepare and submit individual drill site design plans to the BLM for approval prior to initiation of construction. These plans will show the layout of the drill pad over the existing topography, dimensions of the pad, volumes and cross-sections of cut-and-fill, location and dimensions of reserve pit, and access road egress and ingress.

Measure 4: Prior to construction, the Operators will submit a Surface Use Plan of Operations or a POD for each well site, pipeline segment, and access road project. The plan will itemize project administration, time frame, responsible parties, objectives, characteristics of the predisturbance site conditions, topsoil removal, storage and handling, runoff and erosion control, seedbed preparation, seed mixes useful for livestock and wildlife, seed application, fertilization, mulching, site protection, weed and livestock (and other herbivore) control, and monitoring and maintenance. See Appendix B for reclamation recommendations to be used in preparing for these plans as well as recommendations for monitoring revegetation efforts.

Measure 5: The Operators will slope-stake all construction activities when required by the BLM (e.g., steep and/or unstable slopes) and receive approval by the BLM prior to start of construction.

Measure 6: The Operators will locate aggregate sources for any new construction material for use in drill site and access road construction and reconstruction on BLM or State surface. The appropriate surface management agency (BLM or State) must approve these sources, including timing for extraction, prior to use.

2.3.4.2 Resource-Specific Requirements

2.3.4.2.1 Geology/Paleontology

Mitigation measures presented in the Soils and Water Resources sections would avoid or minimize many of the potential impacts to the geologic environment other than to paleontological resources. The following mitigation measures would prevent impacts to paleontology.

Measure 1: If recommended by the BLM, each proposed facility located in areas with known and potential vertebrate paleontological resource significance (Class II) will be surveyed by a BLM-approved paleontologist prior to surface disturbance (USDI-BLM 1987b; 1990a). Also, if paleontological resources are discovered at any time during construction, all construction activities will halt and BLM personnel will be immediately notified. Work will not proceed until paleontological materials are properly evaluated by a qualified paleontologist.

> Effectiveness: Allows definition of further site-specific mitigation needs. Assures paleontological discoveries will receive proper handling.

2.3.4.2.2 Air Quality

Measure 1: Do not allow open burning of garbage or refuse at the drill sites or other facilities.

> Effectiveness: Reduces the potential for air pollution.

Measure 2: When an air quality, soils loss, or safety problem is identified as a result of fugitive dust, immediate abatement will be initiated. The BLM will approve the procedure (e.g., application of water and magnesium chloride) for dust abatement at facility construction sites as well as locations for use and application rates. Water, if approved for this purpose, must be obtained by the Operator from State-approved source(s).

> Effectiveness: Where fugitive dust abatement controls are needed, this measure provides resources and guidelines for their proper use.

2.3.4.2.3 Soils

Measure 1: Reduce the area of disturbance to the absolute minimum necessary for construction and subsequent production activities while providing for safety of the operation. Restrict off-road vehicle activity.

> Effectiveness: Minimizes overall impacts to soils and vegetation, reduces erosion, and enhances stabilization and revegetation success. Narrowing the width of an access road

by just one foot reduces gross disturbance to all resources (as well as construction and mitigation costs) by one acre for every five linear miles of road/pipeline constructed. Soil structural weakness in the area makes restrictions on off-road activity particularly important.

Measure 2: Where feasible, locate pipelines immediately adjacent to roads or other pipelines to avoid creating separate areas of disturbance and reduce the total area of disturbance.

Effectiveness: Minimizes net disturbance and costs.

Measure 3: Implement measures identified in Reclamation Recommendations (Appendix B) throughout construction and rehabilitation activities, as required by the BLM.

Effectiveness: Ensures correct measures have been taken to prevent unnecessary disturbance to the soil resource and ensures adequate measures have been taken to stabilize disturbed areas to minimize erosion, slope failure, and sediment available for delivery to ephemeral and intermittent drainage channels.

Measure 4: Limit construction activities to periods when the soils are dry or not frozen.

Effectiveness: Reduces soil rutting and compaction and enhances ability to selectively handle the topsoil resource separately from subsoils.

Measure 5: Minimize construction activities in areas of steep slopes, and apply special slope stabilizing structures if construction cannot be avoided in these areas.

Effectiveness: Reduces the amount of disturbance in areas difficult to stabilize and reclaim, and also limits potential for slope failure.

Measure 6: Design cutslopes in a manner that will allow retention of topsoil and subsequent revegetation and mulching.

Effectiveness: Enhances revegetation success and slope stability and reduces erosion and off-site sedimentation.

Measure 7: Selectively strip and salvage topsoil or the best suitable medium for plant growth from all disturbed areas to a depth of at least six inches.

Effectiveness: Ensures an adequate amount of suitable plant growth material to enhance revegetation success. Topsoil provides a source for native seeds, microorganisms, and nutrients essential for enhancing revegetation success.

Measure 8: Where possible, minimize disturbance to vegetated cuts and fills on existing roads that are improved.

Effectiveness: Protects existing resources and reduces subsequent reclamation effort.

Measure 9: Install runoff and erosion control measures such as water bars, berms, and interceptor ditches as recommended in Appendix B, as required by the BLM.

Effectiveness: Provides more effective control of runoff rates to minimize erosion of soils.

Measure 10: Install culverts for ephemeral and intermittent drainage crossings. Design all drainage crossing structures to carry the 25- to 50-year discharge event, or as otherwise directed by the BLM.

Effectiveness: Reduces direct impacts to drainage channels from subsequent activities; maintains continuity of water flow.

Measure 11: Implement minor routing variations during access road layout to avoid steep slopes adjacent to ephemeral or intermittent drainage channels. Maintain a 500-foot-wide buffer strip of natural vegetation where possible (not including wetland vegetation) between all construction activities and ephemeral and intermittent drainage channels.

Effectiveness: Reduces potential for slope-related failures and the likelihood of migration of additional sediment into channel courses.

Measure 12: Include in road design adequate drainage control devices and measures (e.g., road berms and drainage ditches, diversion ditches, cross drains, culverts, out-sloping, and energy dissipators) at sufficient intervals and intensities to adequately control and direct surface runoff above, below, and within the road environment to avoid erosive concentrated flows. In conjunction with surface runoff or drainage control measures, use erosion control devices and measures such as temporary barriers, ditch blocks, water bars erosion stops, mats, mulches, and vegetative covers. Implement a timely revegetation program as soon as possible to re-establish the soil protection afforded by a vegetal cover.

Effectiveness: Minimizes erosion-related impacts from water collected by road surfaces to water-related resources.

Measure 13: Upon completion of construction activities, restore topography to near pre-existing contours at the well sites, along access roads and pipelines, and other facilities sites; replace up to six inches of topsoil or suitable plant growth material over all disturbed surfaces; apply fertilizer as required; seed (specified in a reclamation plan); and mulch.

Effectiveness: With proper planning and implementation in all phases from design to reclamation, pre-existing contours and soil productivity can be restored.

2.3.4.2.4 Water Resources

Other mitigation measures listed in the Soils and Vegetation sections also apply to Water Resources.

Measure 1: Implement recommended measures identified in Appendix B, Reclamation Recommendations, as required by the BLM, throughout construction and rehabilitation activities.

Effectiveness: Reduces runoff, erosion, and off-site sedimentation from all disturbed areas and maintains drainage channel characteristics.

Measure 2: Limit construction of drainage crossings to no-flow periods or low-flow periods.

Effectiveness: Minimizes further sedimentation and alterations of drainage channel geometry and flow hydraulics.

Measure 3: Minimize the area of disturbance within perennial, ephemeral and intermittent drainage channel environments.

Effectiveness: Reduce additional sedimentation and alterations in drainage channel profiles and hydraulics.

Measure 4: Well sites, access roads, and pipelines will not be constructed within 500 feet of surface water, wetlands and/or riparian areas. Exceptions to this will be granted by the BLM based on an environmental analysis and site specific mitigation plans.

Effectiveness: Complies with management direction contained in the Great Divide Resource Area Resource Management Plan (RMP) (USDI-BLM 1990a).

Measure 5: Channel crossings will be designed to minimize changes in channel geometry and subsequent changes in flow hydraulics.

Effectiveness: Preserves existing channel characteristics.

Measure 6: Maintain vegetation barriers occurring between construction activities and ephemeral and intermittent channels.

Effectiveness: Maintains natural sediment barriers and reduces potential for increased sedimentation in drainage channels.

Measure 7: Design and construct interception ditches, sediment traps/silt fences, water bars, silt fences and revegetation and soil stabilization measures as recommended in Appendix B as needed.

Effectiveness: Minimizes off-site sedimentation.

Measure 8: Construct channel crossings by pipelines such that the pipe is buried well below the maximum scour depth or a minimum of four feet below the channel bottom.

Effectiveness: Prevents channel alteration and changes in flow hydraulics.

Measure 9: Regrade disturbed channel beds to the original geometric configuration and replace bed material with the same or very similar channel bed material.

Effectiveness: Maintains drainage channel hydraulics.

Measure 10: GWA II operators will case wells during drilling and case and cement all wells as necessary to protect accessible high-quality water aquifers. Good-quality water aquifers are aquifers with known water quality of 10,000 mg/l TDS or less. This will include well casing and welding of sufficient integrity to contain all fluids under high pressure during drilling and well completion.

Effectiveness: Minimizes the potential for groundwater contamination during well drilling and well operation.

Measure 11: The reserve pit will be constructed in cut or compacted and stabilized fill rather than fill materials to reduce the chances of reserve pit failure and leakage and subsequent groundwater contamination. The subsoil material the pit is to be constructed in will be inspected for stability and permeability, and to determine whether reinforcement and/or lining are required. If lining is required, the reserve pit will be lined with synthetic liner at least 12 mils in thickness.

Effectiveness: Reduces the chances of reserved pit failure and leakage and subsequent groundwater contamination.

Measure 12: Ensure the reserve pit is not in danger of overflowing; the maximum containment level will not exceed three feet of freeboard. Shut down drilling operations until the problem is corrected if leakage is found outside the pit.

Effectiveness: Ensures that unreclaimable drilling materials do not escape the reserve pit.

Measure 13: Obtain hydrostatic test water used in conjunction with pipeline testing and all water used during construction activities from sources with sufficient quantities and through appropriations permits approved by the State of Wyoming.

Effectiveness: Protects water rights of downstream users and ensures adequate supplies.

Measure 14: Hydrostatic test water not used in conjunction with other GWA II operations will be discharged in a controlled manner onto an energy dissipator. The water will be discharged onto undisturbed land that has vegetative cover if possible, or into an established drainage channel. Prior to discharge, the water will be treated or filtered to reduce pollutant levels or to settle out suspended particles if necessary. If discharged into an established ephemeral drainage channel, the rate of discharge will not exceed the capacity of the channel to safely convey the increased flow (bankfull discharge stage). All discharge of test water will be coordinated with the State of Wyoming Engineer's office and the BLM.

Effectiveness: Reduces scouring and erosion of receiving area and allows sediments to settle out prior to discharge into drainage channels.

Measure 15: Discharge all concentrated water from surface runoff within access road ROWs onto or through an energy dissipator structure (e.g., riprapped aprons and discharge points) and into undisturbed vegetation.

Effectiveness: Minimizes erosion and scouring flows.

Measure 16: The GWA II operators will develop and implement a Storm Water Pollution Prevention Plan (SWPPP) for storm water runoff at drill sites as necessary per Wyoming Department of Environmental Quality storm water NPDES permit requirements.

Effectiveness: Keeps potentially contaminated water from leaving its site of origin. Reduces contaminants known to be present. Discharge of water into dense vegetation assists in dissipating its erosive energy.

Measure 17: The GWA II operators will exercise stringent precautions against pipeline breaks and other potential accidental discharges of chemicals and pollutants into adjacent streams. If liquid petroleum products are stored on-site in sufficient quantities (per criteria contained in 40 CFR Part 112), an oil spill prevention control and countermeasures (SPCC) plan will be developed in accordance with 40 CFR Part 112, dated December 1973.

Effectiveness: Ensures that liquids will be properly constrained and that plans and tools for responses to accidents will be available in advance of the time of need.

Measure 18: Coordinate all crossings or encroachments of waters of the U.S. with the U.S. Army Corps of Engineers (COE).

> Effectiveness: Ensures necessary authorization of such activities under Section 404 of the Clean Water Act (CWA).

2.3.4.2.5 Vegetation and Wetlands

Mitigation measures under Soils and Water Resources also apply to vegetation.

Measure 1: Implement recommended measures identified in Appendix B throughout construction and rehabilitation activities, as required by the BLM.

> Effectiveness: Ensures correct measures will be taken to prevent unnecessary disturbance to the vegetation resource and that adequate measures will be taken to stabilize disturbed areas.

Measure 2: Seed and stabilize disturbed areas with seed mixtures and treatment measures recommended in Appendix B.

> Effectiveness: Ensures revegetation with desirable plant species designed to provide immediate stabilization, prevent invasion of noxious weeds, and reduce over-competition in order to preclude the recolonization of native species.

Measure 3: Design a noxious weed monitoring program and implement, if necessary, a weed control and eradication program per BLM requirements.

> Effectiveness: Identifies early invasion of undesirable species and reduces the potential negative impacts of these species.

Measure 4: Evaluate all project facility sites for occurrence and distribution of waters of the U.S., including special aquatic sites and jurisdictional wetlands. All project facilities will be located out of these sensitive areas. If complete avoidance is not possible, minimize impacts through modification and minor relocations of facilities. Coordinate activities that involve dredge or fill into wetlands with the COE.

> Effectiveness: Ensures compliance with the CWA, minimizes disturbance, and assures proper mitigation for waters of the U.S. protected under that act.

Measure 5: Per BLM directives (USDI-BLM 6840), a site-specific survey for special status plants and their habitat should be conducted for each facility-specific development where deemed necessary by the BLM prior to initiation of any ground-surface disturbance. If found, minimize and monitor impacts to plant species of concern. Make minor adjustments to the location of project facilities to avoid plant species of concern and/or their habitat.

Effectiveness: Ensures plants species of concern will be discovered and, if present, ensures protection.

2.3.4.2.6 Range Resources and Other Land Uses

Measures listed under Soils, Vegetation and Wetlands, and Wildlife also apply to Range Resources and Other Land Uses.

Measure 1: The Operator will coordinate with the affected livestock operators to ensure that livestock control structures remain functional during drilling and production operations.

Effectiveness: Reduces impacts to the livestock industry.

2.3.4.2.7 Wildlife

Measure 1: Require that regular drivers undergo training describing the types of wildlife in the area that are susceptible to vehicular collisions, the circumstances under which such collisions are likely to occur, and the measures that can be employed to minimize them.

Effectiveness: May reduce the incidence of wildlife-vehicle collisions and deaths that result from such collisions.

Measure 2: During reclamation, establish a variety of forage species that are useful to resident herbivores based on the seed mixes presented in Appendix B or a BLM-approved seed mix.

Effectiveness: Accelerates the return of disturbed areas to useful production of herbivore forage.

Measure 3: Prohibit unnecessary off-site activities of operational personnel in the vicinity of the drill sites. Inform all project employees of applicable wildlife laws and penalties associated with unlawful take and harassment.

Effectiveness: Reduces the potential for increases in general disturbance, active harassment, poaching, and wildlife-vehicle collisions that might otherwise result.

Measure 4: To facilitate big game movements and minimize the potential for injuries, do not fence road access ROWs.

> Effectiveness: Simplifies big game movements and minimizes the potential for injuries incurred during fence-crossing attempts or straying into fences that have been obscured by snow or darkness.

Measure 5: Limit construction activities as per BLM authorizations within the pronghorn antelope crucial winter range from November 15 through May 1.

> Effectiveness: Prevents additional displacement of wildlife during the crucial winter season.

Measure 6: A raptor survey of the GWA II analysis area will be completed prior to construction to ensure that well sites are located away from potential conflict areas. (Note: This mitigation measure has been completed as a part of the analysis for the project EIS).

> Effectiveness: Essential measure for locating well sites away from potential conflict areas.

Measure 7: When an 'active' raptor nest is within 0.75 mile (depending on species and line of sight) of a proposed well site, restrict construction during the critical nesting season for that species.

> Effectiveness: Prevents interruption of nesting raptors.

Measure 8: Conduct aerial surveys of the GWA II analysis area prior to any construction to determine locations of sage grouse leks. Follow-up with ground surveys to determine exact lek locations.

> Effectiveness: Provides current sage grouse lek information concerning new and previously undocumented leks. Also provides current activity status of known leks. This mitigation measure has been completed as a part of the scope of analysis for the project EIS.

Measure 9: Do not perform construction activities within 0.25 mile of existing sage grouse leks at any time except as authorized in writing by exception, waiver, or modification, including documented supporting analysis, by the Authorized Officer (AO).

> Effectiveness: Provides sage grouse lek protection during identified critical sage grouse use periods. Also protects strutting grounds from alteration of habitat.

Measure 10: Do not perform construction activities within a distance specified in the applicable lease stipulation for sage grouse lek protection during the breeding, egg-laying and incubation period (normally March through mid-June).

Effectiveness: Provides sage grouse reproduction protection during identified critical sage grouse use periods.

Measure 11: Prairie dog colonies within the GWA II analysis area will be mapped and consultation with the U.S. Fish and Wildlife Service (FWS) implemented to determine if black-footed ferret searches are necessary. When ferret searches are required, they will be conducted no more than 12 months prior to construction. (Note: Mapping of prairie dog colonies has been completed in the GWA II analysis area as a part of the scope of analysis for the project EIS).

Effectiveness: Essential to ensure that no impacts to black-footed ferrets would occur. Mapping of prairie dog colonies has been completed in the GWA II analysis area as a part of the scope of analysis for the project EIS.

Measure 12: Relocate drilling sites to avoid white-tailed prairie dog colonies.

Effectiveness: Protects white-tailed prairie dogs, burrowing owls, and potential black-footed ferret habitat.

2.3.4.2.8 Fisheries

Measure 1: Apply the Windy Gap Process (see Section 4.8.4 in Chapter 4 and the glossary) in the event of water depletion from Muddy Creek or the Little Snake River.

Effectiveness: Protects candidate fish species habitats from siltation, degradation and generally offsets major impacts.

2.3.4.2.9 Recreation

Measure 1: Minimize conflicts between project vehicles and equipment and recreation traffic by posting appropriate warning signs and speed limits, implementing operator safety training, and by requiring project vehicles to adhere to low speed limits.

Effectiveness: Provides patterns to avoid confrontations between site workers and recreationists.

2.3.4.2.10 Visual Resources

Mitigation for Soils, Vegetation, Wetlands and Air Quality also applies to Visual Resources.

Measure 1: Utilize existing topography to screen roads, pipeline corridors, drill rigs, well heads, and production facilities from view.

> Effectiveness: Directly reduces both immediate visible impacts and consequent mitigation needs.

Measure 2: Paint well and central facilities site structures with flat colors (e.g., Carlsbad Canyon or Desert Brown) that blend with the adjacent surrounding undisturbed terrain, except for structures that require safety coloration in accordance with Occupational Safety and Health Administration (OSHA) requirements.

> Effectiveness: Reduces negative impacts resulting from the industrial character of the well and central facilities sites.

2.3.4.2.11 Cultural Resources

Measure 1: If a site is considered eligible for nomination to, or is on the National Register, avoidance is the preferred method for the mitigation of adverse effects to that property.

> Effectiveness: Prevents impacts to the historic cultural resources.

Measure 2: Mitigation of adverse effects to cultural/historic properties that cannot be avoided will be accomplished by the preparation of a cultural resources mitigation plan in consultation with the BLM, the Wyoming State Historic Preservation Officer, and the Advisory Council on Historic Preservation.

> Effectiveness: Provides compromise pathways.

Measure 3: If cultural resources are discovered at any time during construction, all construction activities will halt and BLM personnel will be immediately notified. Work will not proceed until cultural materials are handled properly by qualified archaeologists.

> Effectiveness: Ensures discoveries will receive proper handling.

2.3.4.2.12 Socioeconomics

Measure 1: Implement hiring policies that will encourage the use of local or regional workers who will not have to relocate to the project area.

Effectiveness: Best meets local employment needs and reduces strain on social resources.

Measure 2: Coordinate project activities with ranching operations to minimize conflicts involving livestock movement or other ranch operations. This will include scheduling of project activities to minimize potential disturbance of large-scale livestock movements. Establish effective and frequent communication with affected ranchers to monitor and correct problems and coordinate scheduling.

Effectiveness: Creates an information exchange pathway for affected parties to minimize potential disturbance to ranching operations.

2.3.4.2.13 Transportation

Measure 1: Develop an area-wide transportation plan for road development and maintenance within the analysis area, identifying the minimum road network required to support operator drilling plans. This plan would utilize existing collector and local roads whenever possible.

Effectiveness: Minimizes new surface disturbance within the area.

2.3.4.2.14 Health and Safety

Measures listed under Air Quality and Water Resources also apply to Health and Safety.

Measure 1: Sanitation facilities installed on the drill sites and any resident camp site locations will be approved by the Wyoming DEQ.

Effectiveness: Provides for adherence to legal standards.

Measure 2: To minimize undue exposure to hazardous situations, require measures that would preclude the public from entering hazardous areas and place warning signs alerting the public of truck traffic.

Effectiveness: Provides warning of potential hazards.

Measure 3: Haul all garbage and rubbish from the drill site to a State-approved sanitary landfill for disposal. Collect and store any garbage or refuse materials on location prior to transport in containers approved by the BLM.

Effectiveness: Helps ensure that garbage and refuse materials are handled appropriately.

Hazardous Materials

Measure 1: During drilling and production operations, the GWA II operators will have a chemical or hazardous substance inventory for all such items that may be at the site. The Operators will institute a Hazard Communication Program for its employees and will require subcontractor programs in accordance with OSHA 29 CFR 1910.1200. It will be required that as every chemical or hazardous material is brought on location, a Material Safety Data Sheet (MSDS) will accompany that material and will become part of the file kept at the field office as required by 29 CFR 1910.1200. All employees will receive the proper training in storage, handling, and disposal of hazardous materials.

Spill Prevention Control and Countermeasure (SPCC) Plans will be written and implemented as necessary in accordance with 40 CFR Parts 112 to prevent discharge into navigable waters of the United States.

Chemical and hazardous materials will be inventoried and reported in accordance with the Superfund Amendments and Reauthorization Act (SARA) Title III. 40 CFR Part 335, if quantities exceeding 10,000 pounds or the threshold planning quantity (TPQ) are to be produced, stored, transported, or disposed of in association with the proposed action. The appropriate Section 311 and 312 forms will be submitted at the required times to the State and County Emergency Management Coordinators and the local fire departments.

Any hazardous wastes, as defined by the Resource Conservation and Recovery Act (RCRA), will be transported and/or disposed of in accordance with all applicable federal, state, and local regulations.

The Operators plan to design operations to severely limit or eliminate the need for extremely hazardous substances. The Operators also plan to avoid the creation of hazardous wastes as defined by RCRA wherever possible. See Appendix D for the Hazardous Materials Management Plan (HMMP).

Effectiveness: The above measures provide compliance with existing regulations on handling and identification of hazardous materials by the Operators. Indicated programs are designed to educate and protect the employees and subcontractors with respect to any chemicals or hazardous substances that may be present in the work place.

2.3.4.2.15 Noise

Measure 1: Muffle and maintain all motorized equipment according to manufacturers' specifications.

Effectiveness: Reduces sound output to its engineering design optimum.

2.4 ALTERNATIVE A - THE OPERATORS WOULD DEVELOP 300 WELLS (AT 250 LOCATIONS) IN ADDITION TO EXISTING OPERATIONS

Alternative A provides for an optimal development scenario of 300 wells built at 250 locations, along with related activities and facilities. This alternative assumes that planned experimental drilling and production techniques would be moderately successful, resulting in development of some, but not all, marginal properties within the analysis area. The minimum 225 wells at 200 locations would be developed during 1994 through 1996 as described under Alternative B, with the remaining 75 wells (at 50 well locations) developed from 1996 and beyond.

The technical requirements for Alternative A are the same as described for the Proposed Action, other than less overall site disturbance requirements necessary for the well sites, access roads, and pipelines.

Total disturbance due to construction of this alternative would involve 1,250 acres due to drill-site construction, 758 acres due to road/pipeline construction, and seven acres due to ancillary facilities for a total of 2,015 acres. This total represents approximately 0.6 percent of the GWA II analysis area. During the production phase, this total would be reduced to 1,138 acres through reclamation of 2.9 acres of disturbance associated with each drill site and 10 feet of the 50-foot wide road pipeline ROW. Thus, total disturbance would be reduced rom 0.6 percent to 0.3 percent of the GWA II analysis area.

2.5 ALTERNATIVE B - THE OPERATORS WOULD DEVELOP 225 WELLS (AT 200 LOCATIONS) IN ADDITION TO EXISTING OPERATIONS

Alternative B provides a minimum development scenario of 225 wells at 200 locations, with related activities and facilities. Should the planned experimental drilling and production techniques prove not to be economically viable, then the minimum 225 wells (at 200 locations)would be developed during 1994 through 1996. Additional drilling as described in the Proposed Action would not be completed by the Operators. Additional infill activity in 1994 through 1996 would likely be an expansion southward to include drilling of additional wells within the Echo Springs and Standard Draw Spacing Areas.

The technical requirements for Alternative B are the same as described for the Proposed Action, other than less overall site disturbance requirements necessary for the well sites, access roads, and pipelines.

Total disturbance due to construction of this alternative would involve 1,000 acres due to drill-site construction, 606 acres due to road/pipeline construction, and seven acres due to ancillary facilities for a total of 1,613 acres. This represents approximately 0.5 percent of the GWA II analysis area. During the production phase, this total would be reduced to 905 acres through reclamation of 2.9 acres of disturbance associated with each drill site and 10 feet of the 50-foot wide road/pipeline ROW. Thus, during production, total disturbance would be reduced from 0.5 percent to 0.3 percent of the GWA II analysis area.

2.6 ALTERNATIVE C - NO ACTION

Section 1502.14(d) of the National Environmental Policy Act (NEPA) requires that the alternatives analysis in the EIS "include the alternative of no action." Selection of this alternative implies that the BLM would allow ongoing natural gas production activities to continue in the GWA II analysis area, but the proposed full field development program and the other development alternatives would be disallowed. Additional APDs and ROW actions would be granted by the BLM on a case-by-case basis. Transport of natural gas product would be allowed from those wells within the GWA II analysis area that are currently productive.

The Department of the Interior's authority to implement a "No Action" alternative is limited as follows. An oil and gas lease grants the lessee the "right and privilege to drill for, mine, extract, remove and dispose of all oil and gas deposits" in the leased lands, subject to the terms and conditions incorporated in the lease (Form 3110-2). Because the Secretary of the Interior has the authority and responsibility to protect the environment within federal oil and gas leases, restrictions are imposed on the lease terms.

Leases within the GWA II analysis area contain various stipulations concerning surface disturbance, surface occupancy, and limited surface use. In addition, the lease stipulations provide that the Department of the Interior may impose "such reasonable conditions, not inconsistent with the purposes for which [the] lease is issued, as the [BLM] may require to protect the surface of the leased lands and the environment." None of the stipulations, however, would empower the Secretary of the Interior to deny all drilling activity because of environmental concerns.

Provisions in leases that expressly provide Secretarial authority to deny or restrict APD development in whole or in part would depend on an opinion provided by the FWS regarding endangered or threatened species or habitats of plants or animals that are listed or proposed for listing (e.g., bald eagle). If the FWS concludes that the proposed action and alternatives would likely jeopardize the continued existence of any endangered or threatened plant or animal species, then the APD(s) and GWA II development may be denied in whole or in part.

As indicated previously, under this alternative, no new development would be authorized beyond the levels previously authorized. The GWA II analysis area is not pristine; the area has been subjected to numerous disturbance activities. As discussed in greater detail in the next section, the current level of disturbance within the GWA II analysis area is approximately 12,527 acres or 3.74 percent.

2.7 COMPARISON OF THE FIELD DEVELOPMENT ALTERNATIVES AND CUMULATIVE EFFECTS

2.7.1 Comparison of Field Development Alternatives

The three field development alternatives analyzed in this EIS are compared. The Proposed Action is the projected disturbance caused by the implementation of the maximum development program of 750 wells at 300 well locations. Alternative A is the disturbance associated with 300 wells at 250 locations. Alternative B represents a minimum level of site disturbance associated with 250 wells at 200 locations.

Each development alternative would involve clearing land and installation of well sites, access roads, pipelines, and associated facilities. Where practical, pipelines would be routed along existing and/or new roadways, with an estimated disturbance width of 50 feet and an estimated length of 0.5 mile per well site. As such, the new road/pipeline combination to each well site is estimated to impact 3.03 acres. The average well site disturbance is estimated to be five acres to construct the typical 3.67-acre drill site (400 feet by 400 feet), including cut-and-fill slopes and other ancillary areas such as topsoil piles.

Given these estimated impact values, the Proposed Action would affect 2,416 acres (1,500 acres for drill pads, 909 acres for road/pipeline, and seven acres for compressor station). Alternative A (intermediate level) would affect 2,015 acres (1,250 acres for well pads, 758 acres for road/pipeline, and seven acres for compressor station). Alternative B would affect 1,613 acres (1,000 acres for well pads, 606 acres for road/pipeline, and seven acres for compressor station).

2.7.2 Cumulative Effects

Cumulative effects are impacts likely to occur due to the proposed project in combination with other ongoing activities, recently constructed projects, and projects likely to be implemented in the near future. Cumulative effects are both additive and interactive. Chapter 4 discusses these effects in each resource section. This section identifies the basic existing cumulative disturbance within the GWA II analysis area and identifies other projects in the general vicinity of this analysis area that could be considered both additively and interactively.

Since the cumulative impacts assessment involves the degree of existing disturbance, detailed photo interpretation was accomplished for the GWA II analysis area (aerial photography taken May 1994). All discernable existing disturbance was identified, delineated, and mapped using the current aerial photography. A Geographic Information System (GIS) was used to develop a base map of existing disturbance within the GWA II analysis area as well as a digital database that can be manipulated by computer software for analysis purposes. This process is described in greater detail in the Soils and Water Resources Technical Report. Ten categories of disturbance were identified in this process (Table 2-8) and the area of impact determined relative to the total GWA II analysis area (334,191 acres of mixed federal, state, and private lands).

Based on 92 acres of drill site (i.e., currently being drilled) and 908 acres of well site (i.e., existing production well) impacts and assuming a disturbance of 3.67 acres per well pad, the GWA II analysis area had 25 drill sites and 247 production wells at the time the aerial photography was taken. This represents eight percent of the existing disturbance. Existing roads, pipelines, and facilities impact 43.8 percent, 37.3 percent, and 1.4 percent, respectively. Urban and railroad categories comprise 4.1 percent and 5.4 percent of the existing GWA II analysis area disturbance and are associated with the area around Wamsutter. The total existing disturbance is 12,527 acres, or approximately 3.7 percent of the 334,191 acres in the analysis area.

Site disturbance resulting from implementation of the Proposed Action and Alternatives A and B would add cumulatively to the degree of disturbance within the GWA II analysis area. The 2,416 acres of impact for the Proposed Action would increase the total area of disturbance within the GWA II analysis area to 14,943 acres, or 4.5 percent of the analysis area. Alternative A would bring the total disturbance to 14,542 acres (4.4 percent). The minimum development action, Alternative B, would produce approximately 14,140 acres of cumulative impact, or 4.2 percent. These figures do not take reclamation into account. Table 2-9 summarizes the additive effect of the Proposed Action on cumulative disturbance within the GWA II analysis area both during the construction phase and the production phase.

In addition to cumulative impacts within the GWA II analysis area, other development projects have been, are being, or are proposed for development within the general GWA II analysis area vicinity. Examples of such projects include the Creston/Blue Gap gas project, Cheyenne Stage I and II pipelines, Uinta Basin Lateral pipeline, Hay Reservoir infill drilling, Mulligan Draw well field development, proposed Sandstone Reservoir, Moxa Arch expansion, proposed Carbon County underground coal gassification, and the Kennecott Green Mountain mine. Depending on the cumulative impact area considered by each resource element, these projects may or may not have a cumulative effect. Many of these projects are located outside the GWA II analysis area, but are important components of the cumulative impact analysis. Exhibit 2-15 shows the location of some of these projects in the general vicinity of the GWA II analysis area. These projects are discussed in greater detail in Chapter 4, Environmental Consequences.

2.8 ALTERNATIVES CONSIDERED BUT NOT ANALYZED IN DETAIL

Alternatives considered but not further evaluated include possible variations in well spacing. As noted in Chapter 1 and provided in approved Unit Agreements and Spacing Orders, spacing limitations are imposed within the entire GWA II analysis area. These fields are predominantly spaced for two wells per section.

Table 2-8. Existing Disturbance within the GWA II Analysis Area.

Disturbance Feature	Area of Impact (acres)	Percent of Existing Disturbance	Percent of Total Area in GWA II
Urban	510	1.4	0.15
Railroad	676	8.0	0.20
Roads			
Public Roads	1,066	8.5	0.32
Collector Roads	784	6.3	0.23
Local Roads	1,726	13.8	0.52
Resource Roads	1,469	11.7	0.44
Unimproved Roads	435	3.5	0.13
Subtotal Roads	5,480	43.8	1.64
Pipelines	4,688	37.3	1.40
Drill/Well Sites	1,000	8.0	0.30
Facilities Sites	173	1.4	0.3[illegible]
TOTAL	**12,527**	**100.0**	**3.74**

Amoco made application to the WOGCC in April 1994 to de-space the Standard Draw Field, Coal Gulch Field, and portions of Wild Rose Field. This de-spacing proposal was approved and allows for a second well to be drilled on each 640-acre drilling unit (i.e., wells would be located on a 320-acre spacing pattern or two wells per section). UPRC also received approval from the WOGCC in April 1994 to de-space seven sections in the Siberia Ridge Field. The spacing order provides for the drilling of an optional second, third, and fourth additional well in each 640-acre unit from the Mesaverde Group. Basically, the spacing order allows additional wells to be located in undrilled quarter-sections of the 640-acre drilling unit for seven sections.

Other development wells within the GWA II would be drilled on the established spacing pattern provided for by WOGCC Rule 302. Because of the existing limitations on well spacing as described above, no additional alternatives involving variations in well spacing were considered and analyzed in detail. No other alternatives other than variations in well spacing were considered or evaluated.

Table 2.9 Summary of Cumulative Disturbance within the GWA II Analysis Area Due to Existing Disturbance and the Proposed Action.

Facility Type	Existing Disturbance	Proposed Action							
		Construction Disturbance				Production Disturbance			
		New Disturbance Area	Cumulative Total	Cumulative Percent	Percent of GWA II	Residual Disturbance	Cumulative Disturbance	Cumulative Percent	Percent of GWA II
Urban	510	0	510	3.4	0.15	0	510	3.70	0.15
Railroad	676	0	676	4.5	0.20	0	676	4.90	0.20
Roads/ Pipelines	10,168*	909	11,077	74.2	3.32	727	10,895	78.40	3.26
Well Sites	1,000	1,500	2,500	16.7	0.75	630	1,630	11.70	0.49
Facilities Sites	173	7	180	1.2	0.05	7	180	1.30	0.05
TOTAL	**12,527**	**2,416**	**14,943**	**100.0**	**4.47**	**1,364**	**13,891**	**100.0**	**4.15**

* - a large portion of this area has been/will be reclaimed.

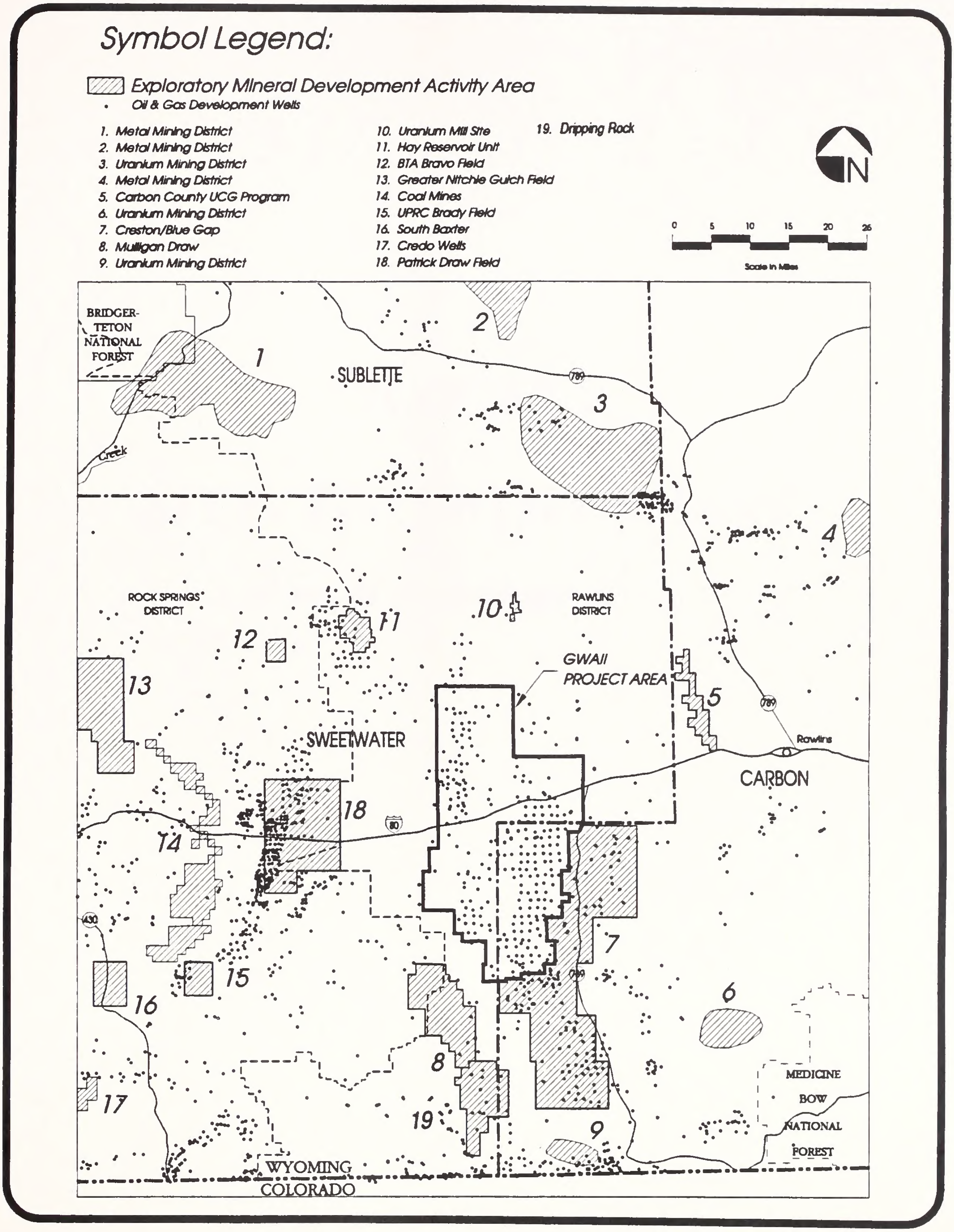

Exhibit 2-15. Other Minerals Development Projects in the Vicinity of the GWA II Analysis Area.

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CHAPTER 3

AFFECTED ENVIRONMENT

CHAPTER 3

AFFECTED ENVIRONMENT

3.0 INTRODUCTION

The Affected Environment chapter of this environmental impact statement (EIS) for the proposed Greater Wamsutter Area II Natural Gas Production project discusses environmental, social, and economic factors as they currently exist within the analysis area. The material presented here has been guided by management issues identified by the Bureau of Land Management (BLM) Great Divide Resource Area, public scoping, and by interdisciplinary field analysis of the area.

This proposal could potentially affect critical elements of the human environment as listed in BLM NEPA Handbook H-1790-1 (USDI-BLM 1988). These critical elements are air quality, cultural resources, floodplains, Native American religious concerns, threatened and endangered species, wastes (hazardous or solid), water quality, and wetlands/riparian zones. Four critical elements (areas of critical environmental concern, prime and unique farmlands, wild and scenic rivers, and wilderness areas) are not present and are not addressed further. In addition to the critical elements, this EIS discusses potential effects of the project on geologic/paleontologic resources, soils, wildlife, noise, visual resources, recreation, socioeconomics, range resources, and health and safety.

3.1 GEOLOGY/PALEONTOLOGY

3.1.1 Geology

3.1.1.1 Regional Geologic Overview

The Greater Wamsutter Area occupies the east central part of Sweetwater County and part of adjacent Carbon County, Wyoming and lies within the eastern part of the greater Green River Basin. This basin is a large intermontane structural and topographic basin which is part of the Wyoming Basin Physiographic Province. This province is characterized by large intermontane structural basins bounded by mountain uplifts that have Precambrian rocks at their cores. The greater Green River Basin between the uplifts began developing about 70 million years ago; it filled with sediments eroded from surrounding highlands and mountains during the late Cretaceous and early Tertiary periods. General structural elements occupying the eastern part of the greater Green River Basin include the Rock Springs Uplift which bounds the area to the west and the Rawlins Uplift which bounds the area to the east. The area lies between the two uplifts and straddles an east-trending structural high, the Wamsutter Arch, a broad east-plunging anticline with a poorly defined axis developed between them. The Great Divide and Red Desert Basins lie north of the arch. These basins are bounded to the north by the Granite and Wind River Mountains. The Washakie Basin lies south of the arch and is bound south and east by Cherokee Ridge and the Sierra Madre, respectively. Several northeast trending normal faults have been mapped in the area, but none of these have been shown to have had movement in the last two million years (Case et al. 1994).

Geologic mapping by the USGS and Wyoming Geologic Survey (Bradley 1964; Love 1970; Love and Christiansen 1985; Love et al. 1993; and Roehler 1977, 1985) document that sedimentary deposits of Quaternary and early Tertiary age crop out in the project area. These sedimentary deposits are underlain at depth by Phanerozoic sedimentary rock which, except for the lack of Silurian and Ordovician age deposits, range in age from Cretaceous to Cambrian. The Phanerozoic sediments are underlain by Precambrian metamorphic bedrock that comprise part of the ancient North American cratonic shield. A geologic map of the GWA II analysis area is shown as Exhibit 3-1. Information on the geologic units preserved beneath the project area is provided in Table 3-1. More detailed information on the geologic deposits exposed at the surface of the area is provided in Table 3-2.

Quaternary Deposits. A variety of unconsolidated or semi-consolidated sediments of Quaternary age occur at the surface of the project area. These sediments include: alluvium, colluvium, terrace gravel, dune sand, loess, playa lake and other lake deposits (Love and Christiansen 1985; Love et al. 1993; Grasso 1990; Mears 1987). Alluvium and colluvium composed of clay, silt, sand, and gravel of late Holocene age are preserved at widespread locations on floodplains, terraces and slopes across the area. Clay, silt, sand and travertine of similar age is preserved chiefly at widespread locations in modern playa lakes developed in the Red Desert and Great Divide Basins and to a lesser degree in the Washakie Basin. Older lake deposits and associated remnant shorelines, deltas, and spillway deposits cover a large part of the central Great Divide Basin. A continuous blanket of these deposits extends throughout the Red Desert Basin into Dry Lake, south of Wamsutter. A second expansive accumulation of these deposits extends throughout Lost Creek Basin, Battle Springs Flat, and Chain Lake Flats. Although partly buried by eolian sands, these lake deposits lie at elevations well beyond and above the limits of modern playas, and appear to have accumulated in an older, more persistent lake. This lake, dubbed Lake Wamsutter (Grasso 1990) probably reached its maximum extent sometime during the late Pleistocene (circa 12,000 to 20,000 years ago) at which time it may have been more than 200 feet deep. Dune sand and loess of similar age that accumulated along the shoreline of this lake occurs in the northern part of the project area and along the east flank of the Washakie Basin.

Tertiary Deposits. Early Tertiary sedimentary deposits preserved in the project area accumulated in terrestrial and lake environments that dominated the eastern part of the Greater Green River Basin during the Paleocene and Eocene ages (Bradley 1964; Love 1970; Piperingos and Denson 1970; Roehler 1973, 1987, 1991 a-b; 1992 a-c, 1993; Roehler et al. 1988; Winterfeld 1982). Sediments of the Fort Union Formation record deposition in rivers, streams, floodplains, ponds, and swamps that occupied the basin during the Paleocene period. Sediments of the lower part of the Wasatch Formation, which overlie the Fort Union, document continued deposition in floodplain and pond conditions during the early Eocene period. Deposits of the Wasatch Formation document the first occurrence of large lakes in the basin during the Tertiary period. Sediments of the Green River Formation, which overlie the Wasatch, record the history of large lake systems (Lake Luman and Lake Gosiute), that experienced many cycles of expansion and

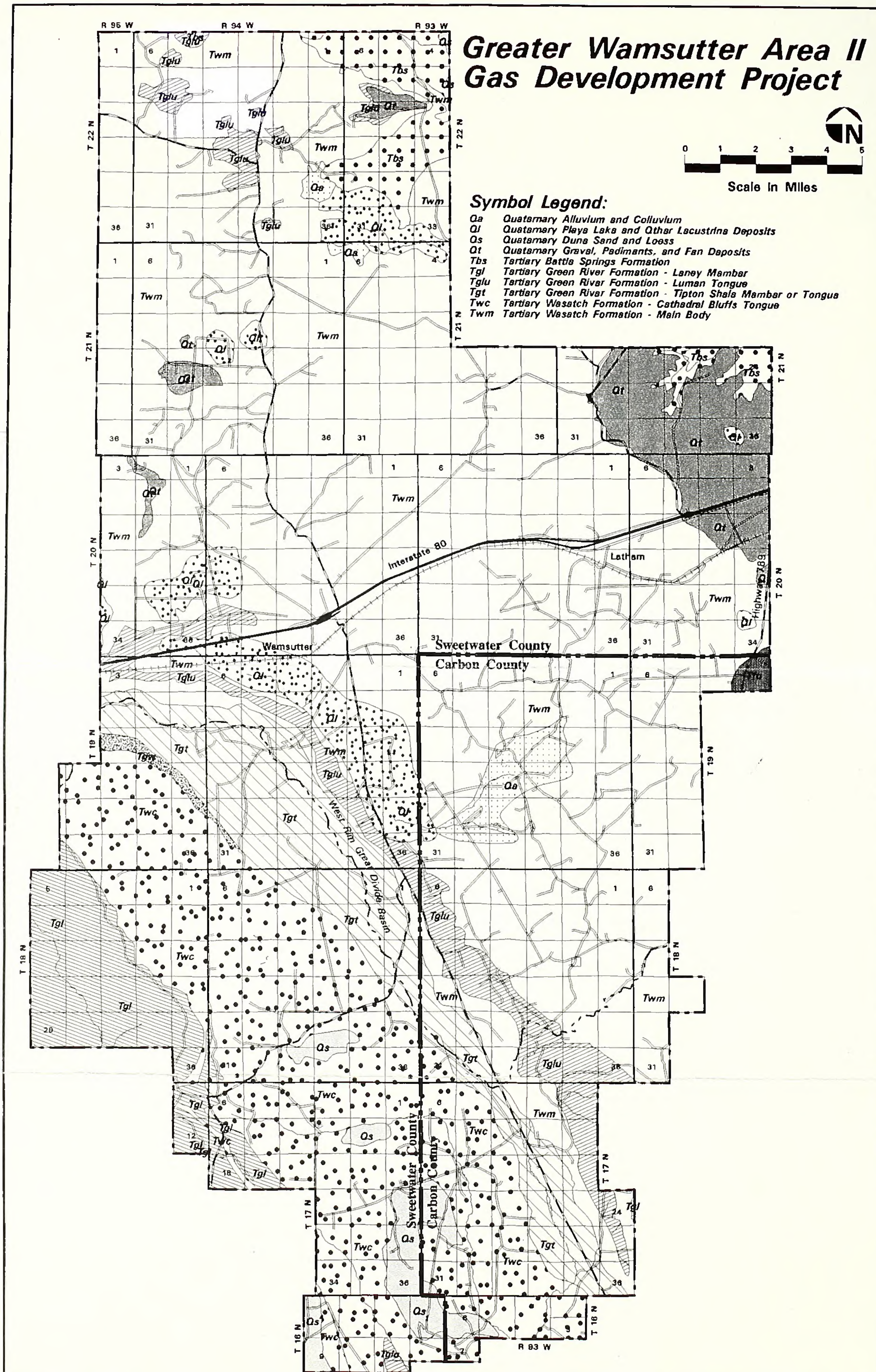

Exhibit 3-1. Geologic Map of the GWA II Analysis Area.

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Table 3-1. Subsurface Geologic Deposits in the GWA II Analysis Area.

Geologic Deposit	Geologic Age	Environment/Lithology
Lance Formation (or equivalent)	Late Cretaceous	Terrestrial/marine, brown and gray sandstone , shale and mudstone, coals, and carbonaceous shales.
Fox Hills Sandstone	Late Cretaceous	Marine/shoreline, light-colored sandstone and gray sandy shale
Lewis Shale	Late Cretaceous	Marine, gray shale containing gray, brown sandstones
Almond Formation	Late Cretaceous	Marine/deltaic/terrestrial, white and brown sandstone, sandy shale, coal, carbonaceous shale
Ericson Sandstone	Late Cretaceous	Marine, white sandstone, lenticular conglomerate
Rock Springs Formation	Late Cretaceous	Marine, white to brown sandstone, shale, mudstone, coal
Baxter, Cody, Steele Shales	Late Cretaceous	Marine, gray shale, with numerous bentonites, sandstone
Niobrara Formation	Late Cretaceous	Marine, light-colored limestone, gray limy shale
Frontier Formation	Late Cretaceous	Marine/deltaic, gray sandstone and sandy shale
Mowry Shale	Late Cretaceous	Marine, silver-gray, hard siliceous shale, with abundant fish scales and bentonites
Muddy Sandstone	Early Cretaceous	Marine/deltaic, gray to brown sandstone, conglomeratic
Thermopolis Shale	Early Cretaceous	Marine, black, soft, fissile shale

Table 3-1. **Subsurface Geologic Deposits in the GWA II Analysis Area, Continued.**

Geologic Deposit	Geologic Age	Environment/Lithology
Cloverly Formation	Early Cretaceous	Terrestrial, variegated mudstone, bentonitic, conglomeratic sandstone
Morrison Formation	Jurassic	Terrestrial, vari-colored mudstones, white sandstone, bentonite
Sundance Formation	Jurassic	Marine, green-gray glauconitic sandstone and shale, underlain by red and gray non-glauconitic shale and sandstone
Nugget Sandstone	Triassic to Jurassic	Eolian, gray to red, massive to cross-bedded sandstone
Chugwater Formation	Triassic	Terrestrial/mudflat, red shale and siltstone, sandstone
Dinwoody/Goose Egg Formations	Permian to Triassic	Marine, gray to olive dolomitic siltstone (Dinwoody); red sandstone and siltstone, gypsum, halite, purple to white dolomite and limestone (Goose Egg)
Phosphoria/Goose Egg Formations	Permian	Marine, dark to light gray, green to black, glauconitic shale and sandstone, phosphatic sandstone and dolomite (Phosphoria)
Tensleep Sandstone	Pennsylvanian	Marine, white to gray sandstone with limestone and dolomite
Amsden Formation	Mississippian to Pennsylvanian	Marine, red and green shale and dolomite, persistent red to brown sandstone at base
Madison Limestone	Mississippian	Marine, blue-gray massive limestone and dolomite
Flathead Sandstone	Cambrian	Marine/shoreline, red, banded, quartzose sandstone
unnamed metamorphic rocks	Precambrian	Igneous/metamorphic, granitic and/or intrusive

Sources: Love and Christiansen 1985; Love, Christiansen and Ver Ploeg 1993.

Table 3-2. Summary of Surface Geologic Deposits and Paleontologic Resources in the GWA II Analysis Area.

Geologic Deposit	Geologic Age	Type of Deposit/ Environment of Deposition	Fossil Resources	Paleontologic Potential	Area Present
alluvial sediments (including alluvium, and colluvium)	Holocene	unconsolidated silts, sands of valleys and plains. Terrestrial-fluvial.	none	low	widespread
eolian sediments	Holocene (less than 2,000 ybp)	unconsolidated active and dormant sand dunes, sands and silts. Terrestrial-eolian	none	unknown probably low	Great Divide Basin, east flank of Washakie Basin
playa lake and lake margin deposits	Holocene (to 7,000 ybp)	unconsolidated silts, sands, clays	none	low	Red Desert, north flank Washakie Basin
lake and lake margin deposits	late Pleistocene (12,000 to 20,000 ybp)	unconsolidated silts, sands. Lacustrine and associated deltaic sands, accumulated in and adjacent to Lake Wamsutter	none	unknown, probably high	Great Divide and Red Desert Basins
terrace deposits	Pleistocene	gravels, silts and sands that predate current erosional cycle. Terrestrial-fluvial.	none	unknown, probably low	Creston area
Battle Springs Formation	late Paleocene to Eocene	coarse sandstone, gravels, conglomerates. Terrestrial, alluvial fan, fluvial, accumulated adjacent to Granite Mountains.	plants	low	Great Divide Basin, south flank of Granite Mountains
Washakie Formation	middle Eocene (Bridgerian to Uintan)	tuffaceous sandstone and bentonitic mudstone, limestone. Terrestrial-fluvial, floodplain, accumulated after drying up of Lake Gosiute.	vertebrates, invertebrates, plants, trace fossils	high	Washakie Basin, Haystacks area
Green River Formation Godiva Rim Member	middle Eocene	drab-colored sandstone, siltstone, mudstone. Terrestrial, floodplain, lake mudflat surrounding east side of Lake Gosiute.	vertebrate, invertebrate, trace fossils	high	northeast flank Washakie Basin

Table 3-2. Summary of Surface Geologic Deposits and Paleontologic Resources in the GWA II Analysis Area, Continued.

Geologic Deposit	Geologic Age	Type of Deposit/ Environment of Deposition	Fossil Resources	Paleontologic Potential	Area Present
Green River Formation Laney Shale Member Hart Cabin Bed	middle Eocene	drab-colored sandstone, siltstone, mudstone. Terrestrial-fluvial, accumulated during drying up of Lake Gosiute	vertebrates, invertebrates	high	northeast flank Washakie Basin
Green River Formation Laney Shale Member Laclede Bed	middle Eocene	chiefly oil shale, lesser algal limestone, sandstone, claystone and tuff. Lacustrine, accumulated during renewed expansion of Lake Gosiute.	vertebrates, invertebrates, trace fossils	high	northeast flank Washakie Basin
Wilkins Peak Member lower part	middle Eocene	chiefly cyclic deposits of oil shale, trona, halite, mudstone, lesser sandstone, limestone. Lacustrine, accumulated during restriction of Lake Gosiute.	vertebrates, invertebrates, plants, trace fossils	high	northeast flank Washakie Basin
Green River Formation Tipton Shale Member Rife Bed	middle Eocene	chiefly oil shale, lesser algal limestone, dolomite, sandstone and mudstone. Lacustrine, accumulated during restriction of Lake Gosiute.	invertebrates, stromatolites	low	northeast flank Washakie Basin
Green River Formation Tipton Shale Member Scheggs Bed	middle Eocene	chiefly oil shale, lesser algal limestone, dolomite, sandstone and mudstone. Lacustrine, accumulated during first major expansion of Lake Gosiute.	vertebrates, invertebrates	high	northeast flank Washakie Basin
Green River Formation Luman Tongue	middle Eocene	oil shale, carbonaceous shale, limestone, sandstone and mudstone. Lacustrine, accumulated in Lake Luman.	vertebrates, invertebrates, trace fossil	high	northeast flank Washakie Basin
Wasatch Formation Cathedral Bluffs Member	early Eocene	varicolored, chiefly red sandstone and mudstone. Terrestrial, fluvial, floodplain, accumulated lateral to Lake Gosiute along basin margin.	vertebrates, plants	high	northeast flank Washakie Basin

Table 3-2. Summary of Surface Geologic Deposits and Paleontologic Resources in the GWA II Analysis Area, Continued.

Geologic Deposit	Geologic Age	Type of Deposit/ Environment of Deposition	Fossil Resources	Paleontologic Potential	Area Present
Wasatch Formation Niland Tongue	middle Eocene	drab colored mudstones and sandstones. Terrestrial, floodplain, swamp, pond, accumulated adjacent to Lake Luman.	vertebrates, invertebrates, plants, trace fossils	high	northeast flank Washakie Basin
Wasatch Formation Ramsey Ranch Member	early Eocene	drab colored sandstone, mudstone, shale and coal. Terrestrial, floodplain, swamp, pond, and lake margin.	vertebrates	high	northeast flank Washakie Basin
Wasatch Formation main body	early Eocene	drab to varicolored sandstone, mudstone, coals. Terrestrial, fluvial, floodplain, locally swamp and pond.	vertebrates, invertebrates, plants, trace fossils	high	Red Desert Basin
Fort Union Formation	Paleocene to earliest Eocene	drab colored sandstones, mudstones, coals. Terrestrial, pond swamp and fluvial.	vertebrates, plants	unknown	west flank Rawlins Uplift

The salinity changes reflected in these units correspond to lake expansion, contraction, and final desiccation, which resulted ultimately from climatic conditions affecting southwestern Wyoming during the Eocene. Sediments that accumulated lateral to and following the final drying-up of the Eocene lake system, chiefly in river, floodplain, swamp or pond environments, comprise the upper part of the Wasatch and Washakie Formations. Sediments that accumulated along the basin edges in upland or alluvial fan environments comprise the upper part of the Wasatch (Cathedral Bluffs Member) and Battle Springs Formations.

3.1.1.2 Mineral Resources

Major mineral resources within the project area include petroleum and coal. Petroleum was first discovered in 1948 in the Wamsutter Field where production was encountered in the Upper Cretaceous Almond Formation. The 1970s saw the development of the Wamsutter and Echo Springs/Standard Draw fields within the Almond Formation and development of additional reserves in the Lewis Shale in the Wamsutter Field. More than 500 billion cubic feet (bcf) gas has been produced from the area and surrounding vicinity obtained from sandstone reservoirs in the Lance (Kl), Lewis Shale (Kle), Almond Formation (Kal), Ericson Sandstone (Ke), and Rock Springs Formation (undifferentiated Mesaverde Group/Kmv)(geologic unit symbols are shown in Exhibit 3-1). As shown on Wyoming Geological Survey maps (DeBruin and Boyd 1991), actively producing fields, with their producing horizon in parentheses include: Baldy Butte (Kmv), Barrel Springs (Kl, Kmv, Kal), Coal Gulch (Kmv, Kal), Emigrant Trail (Kl, Kle, Kmv, Kal), Five Mile Gulch (Kle, Kmv, Kal, Ke), Frewen (Kl), Monument Lake (Kmv), Red Lakes (Kmv, Kal), Tierney (Kmv, Kal), and Wild Rose (Kmv, Kal). Presently shut-in fields include: Desert Butte (Kal), Hansen Draw (Kmv), Salazar (Kmv), Shallow Creek (Kl), Red (Kmv), and Well Bluff (Kmv).

Coal-bearing strata of varying thickness occur in the area at the surface in deposits of the Wasatch Formation, and in the subsurface in Paleocene and Cretaceous strata. Strippable coal deposits of sub-bituminous coal have been mapped in the Wasatch Formation to the north and northwest of Wamsutter and between Creston Junction and Creston (Jones 1991). No major coal mining operations have been developed in the area to date although several projects have been evaluated in the past.

Additional mineral resources documented by the Geological Survey of Wyoming (Harris et al. 1985; Harris and Meyer 1986) include uraniferous coal, sodium sulfate (evaporite), pumice, agatized gastropods, zeolites, and clinkers (scoria) as occurring within the project area. More than 60 million pounds of uranium may be contained within strippable coal in the Wasatch Formation in the Great Divide Basin, in concentrations of 0.003 percent or greater. Concentrations of sodium sulfate evaporites occur in unnamed Quaternary deposits at widely-spaced locations in the area north of I-80, between Creston and Red Desert. Pumice deposits occur in the Fort Union Formation north of Creston Junction between the Union Pacific Railroad and I-80 and zeolites and zeolitized minerals occur in tuff beds contained within the Hart Cabin Bed of the Laney Shale Member, Green River Formation. The geology of this bed is described in Appendix E. Low-grade oil shale also occurs in the area in the Laney and other members of the Green River Formation. Construction materials occur at widely spaced locations in the area. Alluvial sands and gravels occur north and south of I-80, in and along modern drainages such as Buck Draw and Creston Draw, and south of I-80 around Echo Springs. Sand and gravel is currently being excavated south of I-80 near Creston Junction. Terrace gravels of the Quaternary age occur along both sides of I-80 at its intersection with Wyoming State Highway 789, as well as at several locations further north, west of Mud Springs. Construction grade wind-blown sand occurs in the northern part of the area south of Circle Bar Lake and in the southern part of the area along Barrel Springs Draw.

3.1.1.3 Geologic Hazards

Potential geologic hazards include landslides, subsidence, and active or suspected active faults. Landslide potential is greatest in areas where steep slopes occur, particularly where geologic dip on rock formations is steep and parallel to slope or where erosional undercutting may occur. No landslides have been mapped in the project area (Case et al. 1991) and slope gradients are relatively mild over most of the area. Areas with unstable soils may also be susceptible to slumping, sliding, and soil creep. A single area of unstable slopes is found in the western part of the area in T19N R94, 95W and T18N R95W along Wamsutter Rim, where slopes are steep.

Seismic activity is low in the area. Surface faults are associated with the Cyclone Rim Fault, the South Granite Fault System, the Continental Fault, and the Washakie Basin Fault System. No faults with Quaternary movement have been mapped within the project area. The epicenter of one earthquake, has been mapped by Case et al. (1994) within the project area just northwest of Wamsutter in T20N R94W. The magnitude of this earthquake, dated November 25, 1966, was not noted.

3.1.2 Paleontology

Paleontologic resources represent non-renewable fossil resources. Significant paleontologic resources are fossils or assemblages of fossils that are unique, unusual, or rare, diagnostically or stratigraphically important, and/or those which add to the existing body of knowledge in specific areas of geology and evolutionary biology. They include fossil remains of plants, aquatic and terrestrial animals, and the traces of these organisms.

3.1.2.1 Applicable Laws, Regulations and Policies

Scientifically significant fossils are protected by a variety of federal laws, regulations and policies, including: Executive Order 12088, the Federal Land Management and Policy Act of 1976; Executive Order 11593, the National Natural Landmarks Program, and the National Environmental Policy Act (NEPA).

3.1.2.2 Paleontologic Potential Criteria for Geologic Formations

Paleontologic potential criteria used to describe the fossil potential of geologic deposits in this investigation are consistent with those embodied in the Draft Guidelines for Mitigation of Paleontologic Resources formulated by the Society of Vertebrate Paleontology (SVP 1990) and under consideration for adoption by the Federal Government. These criteria used are as follows:

High Potential. High potential deposits include, but are not limited to, sedimentary or volcaniclastic formations that contain significant fossils anywhere within their geographical extent, and geologic deposits judged by professional paleontologists to be the correct age or lithology for preservation of significant fossils. Geologic deposits with high potential include not only those with the potential for yielding abundant fossils, but also those with the potential to produce a few significant fossils, large or small, vertebrate, invertebrate, or plant, that may provide new and significant taxonomic, phylogenetic, or stratigraphic information.

Low Potential. Low potential deposits include sedimentary rocks or sediments that previous studies have shown as lacking significant fossils or which may contain only common and nonsignificant fossils or non-diagnostic fragmentary fossil remains.

No Potential. Geologic deposits with no potential include non-fossiliferous intrusive or extrusive igneous rocks, metamorphic rocks, or sediments too young to contain fossils in meaningful stratigraphic context.

Unknown Potential. Geologic deposits with unknown potential include those of undetermined fossil-bearing potential. Detailed field surveys are necessary before these deposits can be classified as high or low potential.

3.1.2.3 Regional Paleontologic Overview

Paleontologic resources within sedimentary deposits in the project area record the history of animal and plant life in Wyoming during part of the Cenozoic Era. The record represented by Cenozoic age deposits spans about 25 million years and includes parts of the early Tertiary and Quaternary Periods.

As described above, surface geologic mapping documents at least eight different geologic deposits in the project area. These include, from youngest to oldest: 1) unnamed deposits of late Holocene age including unconsolidated eolian sands, playa lake sediments, stream gravels, alluvium, and colluvium; 2) unnamed older alluvial and terrace deposits of late Holocene to late Pleistocene age; 3) lake and associated shoreline and delta deposits of Lake Wamsutter of late Pleistocene (circa 12,000 to 20,000 years old); 4) Washakie Formation of middle Eocene age including the Adobe Town and Kinney Rim Members; 5) Green River Formation of middle Eocene age including the Laney, Wilkins Peak, Godiva Rim, Tipton Shale, and Luman Members; 6) Wasatch Formation of early Eocene age, including the main body, Ramsey Ranch and

Cathedral Bluffs Members, and the Niland Tongue; 7) Battle Springs Formation of late Paleocene to middle Eocene age; and 8) Fort Union Formation of Paleocene to possibly earliest Eocene age.

Most of the geologic deposits listed above have a high or unknown paleontologic potential rating, indicating a potential to produce scientifically significant fossils resources. Exceptions include the unnamed deposits of late Holocene age, the Rife Bed of the Green River Formation, and the Battle Springs Formation. The Holocene deposits are probably for the most part too young to contain fossils. With the exception of algal limestone and ostracods the Rife Bed is apparently devoid of fossils (Roehler 1992b and c, 1993). The only known fossils from the Battle Springs Formation are fragmentary, unidentifiable carbonized wood and agatized wood. Apparently no diagnostic taxa have been identified from the formation to date. Although the deposits of Lake Wamsutter are not known to contain fossils, their environment of deposition suggests that fossils may eventually be found within them. Information on the geologic deposits exposed in the project area and their paleontologic potential is summarized in Table 3-2. Additional information on geologic deposits having either a high or unknown paleontologic potential is summarized below.

3.1.2.4 Unnamed Quaternary Sediments

A variety of unconsolidated or semi-consolidated sediments of Quaternary age present in the area are listed in Table 3-2 and described above. Among these deposits only the older dune sand, loess, Lake Wamsutter sediments, and potentially older Pleistocene terrace remnants are old enough to contain scientifically significant fossil resources. The highest potential for the discovery of significant fossils is probably in sediments that accumulated in and adjacent to Lake Wamsutter. Although terrace gravels of Pleistocene age are known to produce significant fossils at widespread localities throughout the western United States, such fossils are rare.

3.2 AIR QUALITY

3.2.1 Climate

Temperature and Precipitation. The GWA II analysis area is classified as having a dry, mid-continental climate. This region is typified by dry, windy conditions. The climate in the area is semiarid, with limited rainfall and long, cold winters. For the purposes of accurate air quality characterization for the GWA II analysis area, the nearest meteorological data station identified in EPA's SCRAM (Support Center of Air Models) database is Rock Springs. The average annual precipitation measured at Rock Springs is 8.43 inches (NOAA 1985). The months of greatest precipitation are April, May and June when approximately 38 percent of the annual rain and snow falls. An average of 49.2 inches of snow falls during the year, with December and January being the two snowiest months (NOAA 1985). Table 3-3 gives the average monthly and annual precipitation for Rock Springs which is approximately 60 miles from the project site.

Table 3-3. Mean Monthly Temperature and Precipitation.[1]

Month	Temperature (°F)	Precipitation (inches)
January	21.6	0.45
February	26.3	0.42
March	32.1	0.60
April	41.9	0.99
May	52.0	1.28
June	61.2	0.99
July	69.1	0.56
August	66.4	0.42
September	56.7	0.72
October	45.8	0.99
November	31.8	0.52
December	24.2	0.46
ANNUAL	**44.1**	**8.43**

[1] Source: NOAA 1985.

The region has relatively cool temperatures with extremes ranging from -37°F to 98°F (NOAA 1985). Table 3-3 shows the average annual and monthly temperatures for Rock Springs. The average annual temperature is 44.1°F. The highest mean monthly temperature occurs in July and is 69.1°F, while the lowest occurs in January, and is 21.6°F. The frost-free season is about two months long.

3.2.2 Winds

The project area is subject to strong and gusty winds. During the winter months, strong winds are often accompanied by snow, producing blizzard conditions and drifting snow. The frequency and strength of windy conditions greatly affects dispersion and transport of pollutants in the region. Because of the strong winds in the area, the potential for atmospheric dispersion is high. Wind data for the years 1984 through 1989 were collected at the Rock Springs Airport. Table 3-4 shows the distributions of wind speed and atmospheric stability class from 1984 through 1989. Atmospheric stability class is the measure of the atmospheric turbulence and affects the potential for pollutant dispersion. The stability is divided into six categories, designated "A" through "F." The greatest pollutant dispersion occurs during stability class "A," and the least occurs during class "F." Table 3-5 shows the wind direction distribution (direction from which the wind blows). The wind direction rose derived from these data is shown in Exhibit 3-2. From

Table 3-4. Wind Speed and Stability Class Distributions.

Wind Speed (knots)	Frequency (percent)	Stability Class	Frequency (percent)
0-3	11.7	A	0.81
4-6	23.5	B	5.18
7-10	28.9	C	11.19
11-16	23.0	D	50.80
17-21	9.7	E	17.54
Greater than 21	3.2	F	14.48

Table 3-5. Wind Direction Frequency.

Direction	Frequency (percent)
N	2.2
NNE	1.5
NE	3.5
ENE	6.8
E	3.5
ESE	2.4
SE	3.9
SSE	3.9
S	5.9
SSW	6.2
SW	6.8
WSW	21.3
W	16.0
WNW	6.8
NW	3.7
NNW	2.0

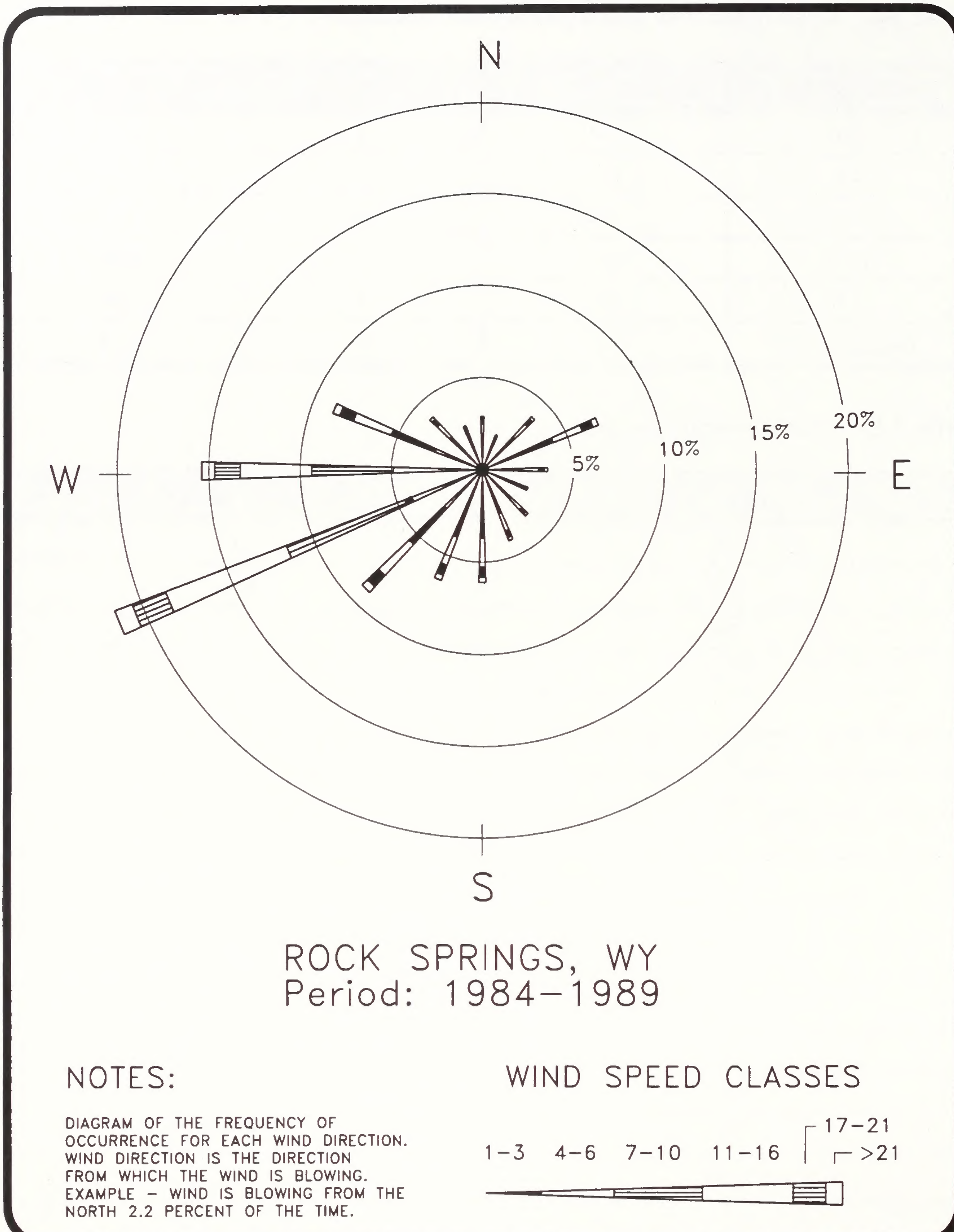

Exhibit 3-2. Wind Direction Rose for the GWA II Analysis Area.

the figure, winds from the west through west-southwest account for over 37 percent of the total. This wind pattern of prevailing westerly winds is fairly consistent throughout the year. The annual mean wind speed is a high 11.4 miles per hour. Wind data at Rock Springs and Rawlins meteorological stations, which are located west and east of the GWA II analysis area, respectively, are similar.

3.2.3 Air Quality

The air quality in the project area is generally very good, having low ambient background concentrations of pollutants. Table 3-6 shows representative background concentrations of SO_2, CO, NO_2, and TSP. These data were collected during 1983 at the Chevron Phosphate Project, located 4.5 miles southeast of Rock Springs, Wyoming (Cote 1984). These data are the most recent measurements made in a remote area near the proposed project that reflect background concentrations unaffected by nearby localized pollutant emission sources. For remote areas, particulate matter less than 10 microns in diameter (PM_{10}) and total suspended particulate (TSP) concentrations would be nearly identical because much of the TSP fraction greater than 10 microns would have settled out. Background concentrations of CO are taken from representative data collected by WDEQ and commercial operators, and summarized in an EIS (USDI-BLM 1983a). Other criteria pollutants (lead and ozone) would be emitted from the applicant's proposed project in quantities so small that they would not be subject to air quality analysis under federal Environmental Protection Agency (EPA) or Wyoming regulation. Consequently, background concentrations of lead and ozone are not addressed in this section.

In addition to the PSD increment regulations, the total ambient concentrations of pollutants, including the existing background concentrations, must also stay below the National Ambient Air Quality Standards (NAAQS) and the Wyoming Department of Environmental Quality (WDEQ) ambient standards. These pollutant concentration limits are shown in Table 3-7.

Table 3-6. Representative Pollutant Background Concentrations.

Pollutant	Averaging Time	Concentration ($\mu g/m^3$)
SO_2	3-hour 24-hour Annual	63 32 2
CO	1-hour 8-hour	3,500 1,500
NO_2	Annual	3
TSP	24-hour Annual	45 12

Table 3-7. Prevention of Significant Deterioration (PSD) Increments.

Pollutant	Averaging Time	Class I Increment (μg/m³)	Class II Increment (μg/m³)
TSP	24-hour	10	37
TSP	Annual	5	19
SO_2	24-hour	5	91
SO_2	Annual	2	20
NO_2	Annual	2.5	25

Note: The EPA has adopted PM_{10} PSD increments (EPA 1994). The PM_{10} increments have not yet been adopted in Wyoming.

The GWA II project area currently meets all applicable ambient air quality standards and is deemed "attainment" for all criteria pollutants. The nearest "nonattainment" area is the trona industrial area approximately 95 miles west of the project area. The trona industrial area is deemed "nonattainment" for secondary PM_{10} ambient standards.

3.3 SOILS

3.3.1 Topography

The range of topography within the analysis area is broad. There are nearly level to gently sloping floodplains and alluvial terraces; alluvial fans as well as moderately sloping terraces and rolling, undulating residual upland hills and terraces. These are broken by steep escarpments and badlands.

3.3.2 Soils

Soils within the analysis area are distributed according to differences in parent material, elevation, moisture, deposition, and topographic slope and position. Baseline soils information was extracted from several sources, including state-wide soil reports (USDA-SCS 1975, U. Wyoming 1977), county-wide data (USDA-SCS 1982a, b), and BLM soils mapping (USDI-BLM 1975-80, 1978, 1987a). In addition, field investigation was utilized to verify existing information, assess existing soil disturbance, and develop field-wide reclamation recommendations.

3.3.2.1 General Soil Characteristics

Soils are included in the Torriorthents-Camborthids-Haplargids association (USDA-SCS 1975, Driver et al. 1984). Such soils formed under a dry, cool (frigid) climate with spring moisture.

Soils of this association have low organic matter and are formed from residuum on bedrock-controlled uplands and in alluvium on playas. These soils formed from the many types of bedrock exposed at the surface such as the Green River, Wasatch, Battle Springs, and Fort Union formations, as well as from lake, wind, and flowing water deposits.

Over 125 soil map units have been delineated within the project area at "Order 3" levels by the BLM (USDI-BLM 1975-1980, 1978, 1987a). The majority of these are included in six soil taxonomic classes (U. Wyoming 1977): Typic Torriorthents, Typic Camborthids, Typic Natrargids, Borollic Haplargids, Typic Haplargids, and Ustic Torriorthents. Detailed information on soil map units and taxonomic classes in the project area is presented in the Soils Technical Report (ECOTONE 1995a), which is hereby incorporated by reference. Of the 334,191 acres of land within the analysis area, nearly all (314,926 acres or 94 percent) are considered sensitive for topsoil or roads or are susceptible to runoff, wind erosion, or water erosion. The balance (19,265 acres or six percent) are non-sensitive soils. Table 3-8 provides a breakdown of sensitivity by category, nature of sensitivity, and area. Information presented in this table was developed by manipulating the BLM's Geographic Information System (GIS) database.

Soil Texture and Slope. Most of the soils in the GWA II analysis area were derived from marine shales, which produce medium- to fine-textured soils. Soil textures primarily consist of variations of loam (e.g., sandy loam, loam, clay loam, silty clay loam, channery loam, etc.) and occur on all topographic positions. Heavier soils (e.g., silty clay or clay textures) occur in bottomlands, basins, and playas. Stratified sands and gravels are present in riverwash associated with streambeds and floodplains, and stabilized, intermittent sand dunes occur in hilly upland areas. Badlands and rock outcrops are formed from shale and sandstone and have little or no soil development due to their predominant erosive feature. Slopes within the project area are generally level to undulating (0 to 10 percent) and broken by areas of steeper slopes (10 to 40 percent).

Soil Depth. Soils are very deep to moderately deep (>60 inches) on alluvial fans, basins, valley alluvium, and residual upland plains. Shallow soils (<20 inches) occur on plains and ravines underlain by sandstone and shale bedrock as well as in areas with steeper topography.

The effective rooting depth approximates the total soil depth or is slightly shallower. The depth to bedrock, however, presents some limitations in the suitability of soil map units for placement of roads.

Soil Permeability. The majority of the soils within the area have moderate permeability and act as good filters. Some areas with sandy soil textures, however, have moderately rapid to rapid permeability. Soils with heavier textures have moderately slow to slow permeability. If compacted, soils become less permeable. Soil crusting also reduces infiltration rates. Most soils in the project area are likely to form a surface crust, particularly if vegetative cover deteriorates.

Table 3-8. Area of Sensitive and Non-Sensitive Soils within the GWA II Analysis Area.[1]

Category	Nature of Sensitivity	Acres[2]	Percent of Total Area[2]
Sensitive			
Topsoil	Poor suitability: too clayey, too sandy, excess salt/sodium, small stones, slope, and/or wetness/flooding	288,911	86
Roads	Severe limitations: low strength, slope, depth to rock, too sandy, and/or wetness	221,321	66
Runoff	Rapid or very rapid	71,904	22
Wind Erosion	Severe or very severe	55,790	17
Water Erosion	Severe or very severe	106,748	32
Cumulative Category		**Acres**	**Percent Total**
Sensitive		314,926	94
Non-Sensitive		19,265	6
TOTAL		**334,191**	**100**

[1] Source: BLM GIS soil map unit database.

[2] Acres overlap for different sensitivity categories; therefore, they do not total the GWA II project area of 334,191 acres. Likewise, the percent of total area does not equal 100 due to overlap.

Bedrock underlying the soils is often fractured, which makes it highly permeable and a poor filter. Soils with a high clay content are subject to cracking upon wetting and drying; tubular cavities can develop as water flows through these cracks. Soils adjacent to major drainages tend to be stratified with repeating layers of finer and coarser soil material. When water reaches these coarser layers, it tends to flow through them.

<u>Soil Productivity and Salinity</u>. Soil productivity is naturally low for most of the GWA II area, but some areas in the eastern part have an intermediate productivity baseline. Soils typically have adequate nitrogen and potassium for plant growth while phosphorous tends to be limited. Precipitation is the chief controlling factor of productivity. Lower precipitation produces less vegetative cover and, consequently, less organic matter for the soil. Soil crusting affects soil productivity by reducing infiltration rates.

Marine shales have a high salt content (USDI-BLM 1987a,b). In the western 80 percent of the project area, precipitation is insufficient to leach salts below the root zone. Soils along the eastern 20 percent are sufficiently leached to produce good vegetative cover. Productivity is highest adjacent to springs and natural drainages that produce free flowing water frequently throughout the year. The additional water flushes salts out of the soil and provides more available moisture for plant growth, reducing the stressful effects of salts on plants. As Table 3-8 indicates, the soils may be poorly suited for use as topsoil due, in part, to the presence of excess salt and/or sodium.

Available Water Capacity. Shallow soils have a lower water-holding capacity than deeper soils. Also, medium-textured soils have a higher available water capacity than heavy soils or coarse textured soils. The average available water capacity is low to moderate.

Seasonal High Water Table. In general, the water table within the project area is greater than six feet below the soil surface. Floodplains, alluvial terraces, seep areas, streambeds, lacustrine flats, and bottoms have an average water table depth of 2.4 feet, with a range of 0.4 to five feet. Flooding is rare and typically brief. Flooding generally is associated with spring runoff and summer storm events. Wetness and/or flooding affects the suitability of soils for use as topsoil and roads in portions of the GWA II analysis area, as indicated in Table 3-8.

Erosion. Soil erodibility due to water and wind varies with soil texture. Silts and silt loams are most susceptible to water erosion. In contrast, fine sands, loamy sands, and coarse sandy loams are most susceptible to wind erosion. Water erosion primarily occurs during spring snowmelt and summer thunderstorms that cause intensive runoff and flash flooding. Many streams in the area have deep, incised channels. These channels continually erode as channel banks cave in and through upstream gully migration. Upland erosion simultaneously occurs due to sheet and rill erosion. The sparse vegetative cover exposes more soil to raindrop impact. Within the GWA II area, soil susceptibility to water erosion is generally slight to moderate but is severe in areas with low permeability. Runoff potential is medium but ranges from slow to very rapid. Overall wind erosion potential is moderate.

Most areas are undergoing moderate natural rates of erosion. Accelerated erosion occurs in localized areas. The Muddy Creek watershed, in which the project area occurs, is undergoing accelerated stream bank erosion (USDI-BLM 1987a). The highest rate of natural, geologic erosion occurs in areas with naturally low vegetative cover, soil crusting, low organic matter content, and soft shales. The wide dispersal of sodium makes soil particles more easily detached by wind and water. Scattered areas of sand dunes are especially easily eroded by wind when vegetation is removed. Areas with greater amounts of vegetative cover and organic matter content and/or lower sodium content have a lower natural rate of erosion by water. In addition, areas with harder rock fragments associated on or near the surface have less erosion. Areas with unstable soils are susceptible to slumping, sliding, and soil creep. Approximately 55,790 acres within the GWA II analysis area have severe or very severe wind erosion sensitivity; 106,748 acres have severe or very severe water erosion sensitivity (Table 3-8).

Soil Strength. Soils throughout the majority of the area have low strength (USDI-BLM 1987a, b). Upon wetting, deformation under a load is a problem. This problem occurs to a lesser extent on the eastern side of the project area. Compaction may be a possible tool to increase strength and to keep deformation under a load to a minimum. As Table 3-8 indicates, low soil strength presents severe limitations for placement of roads on some soil map units.

Reclamation Potential. Salinity, alkalinity, steep slopes, high clay content, sandy soils, small stones, wetness/flooding (i.e., prolonged saturation due to a high water table and/or surface flooding), shallow soils, and low precipitation are all factors that have potential to limit reclamation success. These factors affect the ability to effectively use heavy equipment in reclaiming a disturbed area, the species selected for revegetation, and/or reclamation techniques employed (e.g., mulching, scarification, etc.). Improper reclamation techniques on surface-disturbed areas could produce inadequate amounts of all nutrients and unsuccessful revegetation. Reclamation potential is generally poor to moderate within the GWA II analysis area, with some areas of good potential.

To better characterize reclamation potential of various general soil types within the analysis area, eight soil samples were analyzed. ECOTONE (1995a) describes the results of the sample analysis in greater detail. In general, surface textures were loamy (e.g., loam, sandy loam, clay loam, silt loam, and silty clay loam). Soils in internally-drained topographic basins had salt and sodium levels that would affect reclamation potential. In such soils, special measures are typically needed to reduce sodium levels and achieve adequate revegetation. All soils were deficient in nitrogen; all but one was deficient in phosphorous; only two samples indicated a deficiency of potassium; pH was adequate to normal, with the bottomland samples having high pH. The presence of lime was predominantly adequate/normal.

3.3.2.2 Existing Soil Disturbances

The GWA II area is not pristine; many off-road vehicle tracks created by past livestock management activities, recreationists, and mining activities exist in combination with developed roads for oil and gas development as well as County Roads and the State highway. Chapter 2 discusses the amount and nature of existing disturbances within the GWA II analysis area. As of the date of the aerial photography in May 1994, the total area of existing disturbance was 12,527 acres (3.74 percent). These disturbances to soil and vegetation will continue to be a nucleus for accelerated erosion until they have fully revegetated or become stabilized. Many of the undeveloped trails and two-track roads present a temptation for renewed use, with attendant damage, for vehicles with off-highway capabilities. Similarly, the low topographic relief and vegetation cover, combined with the obvious presence of existing vehicle-created trails, tend to spur the creation of additional tracks unless such behavior is actively managed.

3.4 WATER RESOURCES

Water resources in the project area include both surface water and groundwater. Surface water includes numerous intermittent and ephemeral streams, ephemeral and intermittent lakes, livestock ponds, small detention reservoirs, and seeps and springs. Groundwater resources include free water contained within relatively shallow aquifers that are or could be utilized for culinary, agricultural, and industrial purposes. Therefore, the occurrence and distribution of water resources in the project area are dependent on climate, soils, and structural geology (discussed previously in the Geology Section 3.1).

3.4.1 Precipitation and Climate

Although data from the Rock Springs NOAA station were used to characterize climate relative to air quality, similar data from the Rawlins station is more relevant to the characterization of water resources in the GWA II analysis area.

<u>Climate</u>. The GWA II analysis area occurs in a continental dry, cold-temperate-boreal climate (Trewartha 1968). This climate is primarily characterized by a deficiency of precipitation (i.e., evaporation exceeds precipitation). The area generally has cold temperatures where fewer than eight months have an average temperature greater than 50° F with hot summer days and cool summer nights, but bitterly cold winters. The closest recording weather station to the project area is in Rawlins and is maintained by the USDT Federal Aviation Administration (FAA)(ID #7533) (Martner 1986).

<u>Temperature</u>. The average annual temperature is 42.2° F at Rawlins. The average daily low and high temperatures in January are 6° F and 30° F, respectively. In contrast, the average daily low and high temperatures in July are 48° F and 84° F, respectively. On the average, the hottest day occurs on July 15 (79.3° F) and the coldest day on January 8 (14.1° F). The average number of days per year with a minimum temperature at or below 32° F is 225 days.

<u>Precipitation</u>. Average precipitation is expected to range from seven to 11 inches over the GWA II analysis area with Rawlins having an average of 8.94 inches. Precipitation information developed by the USDI-BLM (1994b) suggests that average annual precipitation within the analysis area is approximately 7.9 inches. Precipitation is generally evenly distributed over the year with peaks in May and October. The majority of precipitation falls as rain from frontal systems and thunderstorms. In regard to intensity of rainfall events, the 50-year, 24-hour precipitation rate is 2.2 inches. Average annual snowfall depth is approximately 78 inches. Due to the effect of ablation and snow drifting, a discontinuous snow cover is usually present during the winter.

<u>Other Climate Characteristics</u>. Mean annual evaporation ranges from 45 inches (lake) to 70 inches (pan) and potential evaporation is 21 inches as compared to the mean annual precipitation of 8.94 inches (Martner 1986). This gives an annual deficit of approximately 12 inches. The prevailing wind is from the west and southwest at an average of 14.3 miles per hour. Violent

weather is relatively common in the area; thunderstorms occur an average of 30 days per year and hail an average of three days per year. A total of eight tornados have been reported in the area since records have been kept at the Rawlins station. These meteorological and climatological characteristics of the project area combine to produce a predominantly dry climate where evaporation exceeds precipitation.

3.4.2 Surface Water

3.4.2.1 Quantity

Surface water is relatively rare or infrequent within the analysis area. Numerous stream channels occur within the GWA II analysis area but the vast majority of the channels are ephemeral (i.e., carry water in direct response to precipitation events only). Table 3-9 lists the major named channels in the GWA II analysis area, their flow class, and drainage basin. Of the major named channels, only Barrel Springs Draw, Coal Gulch, Latham Draw, Standard Draw, and Coal Bank Draw are considered intermediate between ephemeral and intermittent. The GWA II analysis area falls within two general drainage basins including the Great Divide Basin which covers approximately 60 percent of the project area (USDI-BLM 1994a) and the Barrel Springs Draw watershed of the Washakie Basin that discharges into the Muddy Creek drainage which is a tributary to the Little Snake River and on into the Yampa, Green, and Colorado rivers to the Pacific Ocean. The Washakie Basin covers approximately 40 percent of the project area (USDI-BLM 1994a). The surface area within the Great Divide Basin is internally drained; that is, all surface water is retained within the basin without an outlet. Although the Barrel Springs Draw discharges into Muddy Creek, several small portions of the watershed are also internally drained.

Flow within the stream channels correlates with precipitation; surface runoff occurs during spring and early summer as a result of snowmelt and rainfall (Lowham et al. 1985). Streams receive little to no support from groundwater discharge; thus, there are extended periods where drainages contain no flows. Most of the active stream channels in the GWA II analysis area only exhibit ephemeral flow during high-intensity, short-duration, summer thunderstorms. Such events are highly erratic in the project area. Surface runoff may be insufficient in many watersheds (in regard to frequency) to maintain active channels. Most of the stream channels identified on USGS topographic maps are more accurately described as vegetated swales and lack active channels. Specific stream courses may grade between active channels and vegetated swales along their length. Similarly, some of the larger ephemeral to intermittent and intermittent streams may exhibit intermittent flow in one section of the channel and ephemeral flow in another section.

There are no USGS surface water gaging stations in the project area. The USDI-BLM (1994b) has accumulated some surface water discharge data for Barrel Springs and Barrel Springs Draw. Barrel Springs, located west of the project area flows at an average rate of approximately 0.1 cubic feet per second (cfs). Barrel Springs Draw has been measured to have an average flow of less than 1.0 cfs. Muddy Creek, located outside of the project area's southeast and southern borders exhibits an intermittent to perennial flow regime and an approximate average discharge of approximately 14 cfs. This average was calculated from all available periodic flow readings

Table 3-9. Major Named Surface Water Features and Hydrologic Regime in the GWA II Analysis Area.[1]

Streams	Hydrologic Regime	Lakes	Hydrologic Regime	Springs	Hydrologic Regime
Great Divide Basin					
East Fork Sourdough Gulch	E-I	Wamsutter Sewage Lagoons	P	Echo Springs	I-P
Sourdough Gulch	E-I	Monument Lake	E		
Five Mile Ditch	E	Frewen Lake	E		
Creston Draw	E	Twelve Mile Hole	E		
Three Mile Ditch	E	Five Mile Lake	E		
Latham Draw	E-I	Three Mile Ditch Lake	E		
Hansen Draw	E	Government Reservoir	P		
Echo Springs Draw	E-I	Eight Mile Lake	E		
Horse Pasture Draw	E	Coal Bank Lake	E-I		
Standard Draw	E-I	Dry Lake	E		
Coal Bank Wash	E-I	Black Lake	E		
Washakie Basin					
Coal Gulch	E-I	Duck Lake	I		
Little Coal Gulch	E	Red Lakes	E		
Barrel Springs Draw	I				
North Barrel Springs Draw	I				

[1] E-ephemeral; I-intermittent; P-perennial

for the stream near Dad, Wyoming, south of the project area. Base flows (i.e., flow from groundwater seepage during fall, winter, and mid- to late summer) is likely to be approximately one to two cfs. The closest continuously recording USGS gaging station is on Muddy Creek near Baggs, Wyoming (USGS 1994) with an approximate average discharge of eight cfs. Maximum instantaneous and minimum daily recorded flows were 738 cfs and no flow, respectively. Given the relatively dry climate of the project area and lack of well established active channels, mean annual runoff (or watershed yield) is relatively low at less than 0.5 in/year, or about five percent of the total annual precipitation (Wyoming Water Research Center 1990). Existing development in the GWA II analysis area has disturbed approximately 12,530 acres or 3.7 percent of the total project area. As indicated in the Soils Section 3.3.2.1, native soils have a relatively sparse vegetal cover that is nominally effective at detaining excess surface water. The existing level of disturbance has likely not resulted in a substantial increase in surface runoff rates given the character of the native soils.

Numerous ephemeral, intermittent, and perennial lakes are present within the project area. Approximately 96 water features were identified and tabulated in the GWA II analysis area as listed in the Soils and Water Resources Technical Report. Most of these water features are ephemeral and are the result of internal drainage where excess surface water accumulates in the spring and early summer. The vast majority of the lakes are very shallow and do not contain water every year. Based on aerial photographs taken in May of 1994, the only lakes that appear to exhibit intermittent to perennial water regimes are impoundments on larger drainage channels and at springs and seeps. The large ephemeral lakes including Twelve Mile Hole, Black Lake, Monument Lake, Three Mile Ditch Lake, Creston Draw Lake, Frewen Lake, Dry Lake, Red Lakes, Five Mile Lake, and Eight Mile Lake did not exhibit surface inundation in 1994, a drier than normal year. Field review of these ephemeral lakes indicated that inundation likely occurs at a frequency of one or more times in two to five years (i.e., probability of occurrence in any given year of 20 to 50 percent). Most intermittent lakes were located on ephemeral drainages and/or in steep topographic depressions where runoff rates are high. Intermittent to perennial, and perennial lakes are primarily associated with perennial springs and seeps such as Government Reservoir and Echo Springs.

Few perennial springs occur in the project area. The only major named spring shown on USGS topographic quadrangles is Echo Springs. Other perennial springs exist, but are "few and far between." These springs contribute a small amount of perennial inflow to drainages. However, due to evaporation, transpiration, seepage, and freeze-up, the inflow from springs generally extends only a short way downstream from the source. Numerous wells have been drilled in the analysis area to develop drinking water for livestock. Many of these wells, operated by windmills, support small perennial and intermittent impoundments. Oil and gas development has also created wells that discharge perennial water into impoundments for livestock. Locations of many of these surface water features including streams, lakes, springs, and wells are shown in Exhibit 3-3.

Executive Order 11988 requires that federal agencies make decisions in a manner that promotes avoidance of adverse impacts and reduces the risk of property loss and human safety due to development/modification of floodplains and which preserves the natural and beneficial values of floodplains. Several of the larger ephemeral/intermittent washes within the analysis area have floodplains associated with their channels. However, no Federal Emergency Management Act (FEMA) mapping has been accomplished within the area to identify floodplains or designate flood hazard areas. Flooding generally occurs in response to high intensity, localized storms. Such storms initiate most of the floodwater damage, surface erosion, arroyo formation, and sediment deposition in arid and semi-arid environments (Branson et al. 1981). Similarly, most of the

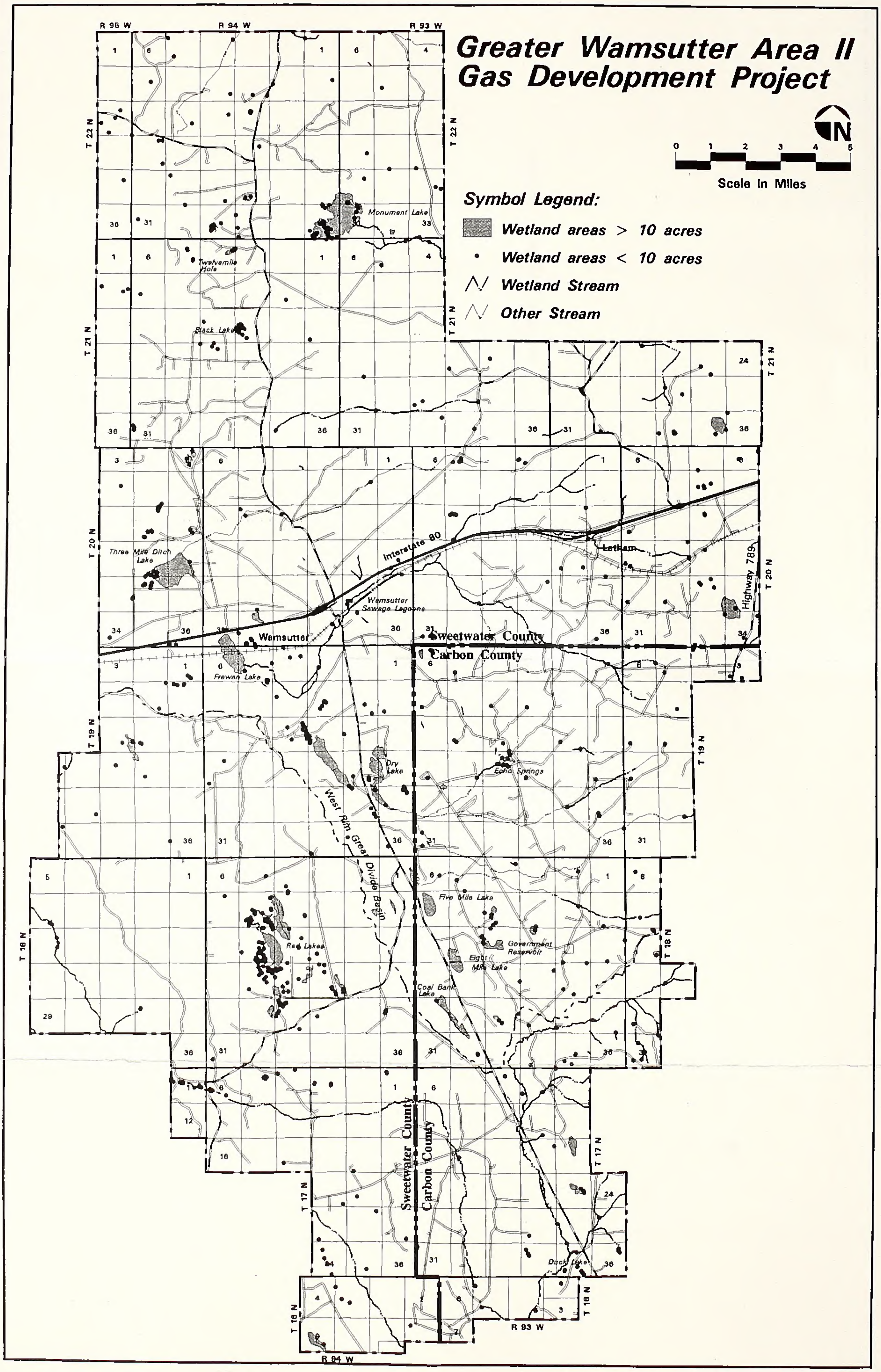

Exhibit 3-3. Surface Water Features and Wetlands within the GWA II Analysis Area.

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internally drained ephemeral and intermittent lakes in the project area may be subjected to infrequent wide-scale flooding and inundation. Many roads and oil and gas development facilities have been constructed in or immediately adjacent to such areas subject to the infrequent flooding.

3.4.2.2 Quality

Surface water quality changes are seasonal and are dependent on the magnitude and source of discharge. In semiarid regions, surface waters typically have a relatively high concentration of dissolved-solids. In general, surface water, when present in the GWA II analysis area, is expected to be of poor to very poor quality for culinary and industrial uses due to high turbidity, suspended solids, and dissolved solids. Point pollution sources have not been documented in the GWA II analysis area. If point sources have occurred, they probably were accidental and are of limited areal extent and short duration. The primary non-point pollution source is natural erosion of geologic units which are easily eroded. Grazing, oil and gas development and mining developments, and poor road construction may further increase the naturally high erosion rates described in the Soils Section (Section 3.3.2). As indicated in Section 2.7.2, approximately 12,257 acres of soil disturbance currently exists within the GWA II area. This disturbance may contribute to non-point pollution of surface waters.

Information developed by the USDI-BLM (1994b) pursuant to the Colorado River Basin Salinity Control Initiative, suggests that the GWA II analysis area may produce sediment at an approximate rate of 0.28 acre-feet per square mile per year. This volume equates to approximately 0.005 inches per year of sediment production. USDI-BLM (1994b) also developed information on salinity levels within the project area. This information suggests that 75 percent of the project area has relatively low salinity levels while the balance, 25 percent, has high salinity levels.

As indicated previously, there are no continuously recording gaging stations within the project area. Various agencies have collected miscellaneous surface water samples for water quality analysis. The USDI-BLM (1994c) has accumulated all available surface water quality data for the project area for Barrel Springs, Barrel Springs Draw, Coal Bank Wash, Echo Springs, and Muddy Creek. The grab sample data suggest the following water quality conditions in the project area. Water temperature is relatively high (>20°F), dissolved oxygen is moderate to high (9 milligrams per liter (mg/l)); conductivity is high (>2,000 to 5,000 mmhos/cm); pH is moderate to high (7 to 10); turbidity is low to moderate (10 to 900 NTU); cations are moderate to high (potassium two to 160 mg/l; sodium is 10 to 4,500 mg/l; carbonates are moderate (1.0 to 700 mg/l); chloride is moderate (5.0 to 6,600 mg/l); sulfate is moderate to high (50 to 4,100 mg/l); total hardness is moderate to high (40 to 990 mg/l); total alkalinity is moderate to high (100 to 2,890 mg/l); and total dissolved solids are high (200 to 12,800 mg/l). Fecal and streptococcus bacteria were present in many samples. This data suggests that surface water quality is not suitable for culinary uses and marginally suited for livestock and industrial uses.

The nearest USGS stations for which water quality data are available are located on Separation Creek (Lowham et al. 1985) and the Little Snake River (Driver et al. 1984, USGS 1992).

Numerous miscellaneous water quality samples were obtained from varying locations outside the project area as part of the Separation Creek Study (Larson and Zimmerman 1981). Water in Separation Creek tends to be slightly to highly alkaline. The average pH value was 8. Total phosphorous concentration averaged 0.16 mg/l, which is slightly above the EPA criterion for stream protection (0.1 mg/l) and the EPA criterion to protect lakes and reservoirs (0.05 mg/l). Separation Creek, similar to many streams in the project area, carries and deposits sediments to the center of the basin. Suspended sediments are predominantly comprised of clay (68 percent); silt (32 percent); and sand (0 percent). Separation Creek had an average suspended sediment concentration of 506 mg/l.

The Little Snake River provides an indication of downstream transport and mixing of surface waters from the project area and similar areas. Water quality in the Little Snake River below Baggs had a low average dissolved solids concentration and which ranged from 10 to 500 mg/l. This value is below the salinity-hazard limit for irrigation practices, 500 mg/l (National Technical Advisory Committee 1968). The average alkalinity concentration of the water (an indication of acid buffering capacity) ranged from 0 to 200 mg/l as calcium carbonate. The water ranged from 0 to 1,000 µg/l in iron concentration. The EPA recommends iron concentration not to exceed 300 µg/l for domestic supplies and not more than 1,000 µg/l for freshwater aquatic life. Recoverable manganese concentrations ranged between 51 to 100 µg/l; EPA recommends 50 µg/l as the maximum concentration for domestic water with a range of 1.5 to over 1,000 mg/l for freshwater aquatic life. Selenium has been identified by the BLM to be a problem within the Little Snake River basin.

The Wyoming Department of Environmental Quality (WDEQ 1990) has classified surface water resources according to quality and degree of protection. Four classes are identified including the following:

Class 1. Surface waters in which no further water quality degradation by point source discharges other than from dams will be allowed. Nonpoint sources of pollution shall be controlled with appropriate best management practices. Considerations employed during the designation of these waters include water quality, aesthetic, scenic, recreational, ecological, agricultural, geological, the presence of significant quantities of developable water, and other values of present and future benefit to people.

Class 2. Surface waters other than Class 1 determined to be presently supporting game fish or have the hydrologic and natural water quality potential to support game fish, or include nursery areas or food sources for game fish.

Class 3. Surface waters other than Class 1 which are determined to be presently supporting non-game fish only, or have the hydrologic and natural water quality potential to support non-game fish only, or include nursery areas or food sources for non-game fish only.

Class 4. Surface waters other than Class 1 which are determined to not have the hydrologic or natural water quality potential to support fish.

All streams within the Great Divide Basin have been designated Class 4 streams. Within the Washakie Basin, Muddy Creek has been designated Class 3. All unnamed tributaries to Muddy Creek have been designated Class 3 as well. Barrel Springs Draw, North Barrel Springs Draw, and unnamed tributaries have been designated Class 4.

The WGFD has also classified surface waters in regard to the quality of fishery habitat and/or the importance of fisheries provided by the surface water bodies. All streams within the GWA II analysis area are Class 5 streams (incapable of supporting fish) (WGFD 1991). As indicated, the Washakie Basin drains through Muddy Creek, a Class 4 stream (low production trout waters/fisheries frequently of local importance, but generally incapable of sustaining substantial fishing pressure) into the Little Snake River, a Class 3 (important trout waters/fisheries of regional importance) and Class 4 stream, which is part of the Colorado River system (WGFD 1991, Collentine et al. 1981).

3.4.2.3 Waters of the U.S.

Most of the surface water features in the project area qualify as Waters of United States. **Waters of the U.S.** include the territorial seas; interstate waters; navigable waterways (such as lakes, rivers, and streams), special aquatic sites, and wetlands that are, have been, or could be used for travel, commerce, or industrial purposes; tributaries; and impoundments of such waters. All channels that carry surface flows and that show signs of active water movement are waters of the U.S. Similarly, all open bodies of water (except ponds and lakes created on upland sites and used exclusively for agricultural and industrial activities or aesthetic amenities) are waters of the U.S. (EPA 33 CFR § 328.3(a)). Such areas are regulated by the EPA and Department of Army Corps of Engineers (COE). As described previously, many of the drainage channels identified on the USGS topographic maps are vegetated swales which are not considered to be waters of the U.S. by the COE. Waters of the U.S. are shown in Exhibit 3-3. Any activity that involves discharge of dredge or fill material into or excavation of such areas is subject to regulation by the COE. Activities that modify the morphology of stream channels are also subject to regulation by the State Engineer's Office of Wyoming. Special aquatic sites and wetlands are discussed in greater detail in the Vegetation Section 3.5.

3.4.3 Groundwater

The project area occurs in the Colorado Plateau and Wyoming Basin groundwater regions described by Heath (1984); the Upper Colorado River Basin groundwater region described by Freethey (1987); or the Great Divide and Washakie Basins by Collentine et al. (1981), and Welder and McGreevy (1966). Groundwater resources include deep and shallow, confined and unconfined aquifers. Site-specific groundwater data for the project area is limited. Existing information comes primarily from oil and gas well records from the Wyoming Oil and Gas Conservation Commission, water-well records from the Wyoming State Engineer and from the U.S. Geological Survey (Weigel 1987). Regional aquifer systems pertinent to the project area are discussed by Heath (1984), Freethey (1987), Driver et al. (1984), and Lowham et al. (1985). Basin-wide evaluations of hydrogeology specific to the project area have been investigated by

Collentine et al. (1981). The best hydrogeologic study specific to the analysis area is by Welder and McGreevy (1966).

3.4.3.1 Location and Quantity

Several rock units can be classified as water-bearing zones (aquifers) within the Great Divide and Washakie basins. They vary in thickness, potential well yields, and water quality. These aquifers are listed and described in Table 3-10. These aquifers include Quaternary deposits, the Tertiary Browns Park and Bridger formations, the Laney Shale Member of the Green River Formation, and the Wasatch and Fort Union Formation; the Upper Cretaceous Lance, Almond, and Frontier formations; the Lower Cretaceous Cloverly Formation; the Jurassic Sundance Formation and Nugget Sandstone; and the Paleozoic rocks. As indicated in Table 3-10, these aquifers are separated by confining layers. Yields vary but are generally low. The main aquifers in the GWA II analysis area are Quaternary alluvium, the Tertiary units, and the Almond Formation. The Quaternary alluvium and the Tertiary units are the only aquifers that are exposed at the surface in the analysis area.

Quaternary alluvium contains units in unconsolidated sand and gravels interbedded with lake and wind-blown sediments. These deposits occur in limited, scattered areas within the GWA II analysis area, particularly at the base of Delaney Rim and around Echo Springs. Well yields are less than 20 gallons per minute (gpm).

Water-bearing units in the Tertiary rocks include sandstones of the Fort Union and Wasatch formations, sandstone and conglomerate of the Battle Springs Formation, and sandstone of the Laney Member of the Green River Formation. Groundwater discharge from these units occurs as seeps and springs in outcrop areas. Well depths in the aquifers range from 50 to more than 3,800 feet. Well yields range from five to 300 gpm.

The nearest groundwater observation well is located west of the analysis area within T19N R95W (Lowham et al. 1985). The well is 1,100 feet deep and is used to monitor water levels in the Wasatch Formation. Driver et al. (1984) indicate that groundwater site data are not available for the Washakie Basin area. However, domestic and stock water can be obtained from wells throughout the area. Yields generally range between five and 50 gpm.

Aquifer recharge results from infiltration of precipitation (direct rainfall, overland flow, and snow melt) in the upland areas between the streams and by upward and/or downward leakage against confining beds. The estimated recharge rate for the area ranges from 0.01 to two inches per year (Heath 1984). This rate is low due to the low amount of precipitation and the presence of confining beds, which hinder the downward movement of water. Groundwater movement is normally toward the center of the structural basins. However, some data indicate discharge across the western boundary of the Washakie Basin into the Green River Basin and across the southern boundary of the Washakie Basin into the Sand Wash Basin in Colorado (Collentine et al. 1981).

Table 3-10. Hydrostratigraphy of Southwest and South-central Wyoming including the Great Divide and Washakie Basins.

Era	Period	Geologic Unit	Thickness (ft)	Hydrologic Properties
Cenozoic	Quaternary		0-70	• Sand and gravel deposits; fine-grained lake deposits produce poor yields • Used extensively in Little Snake River valley and area north of Rawlins uplift • Well yields generally < 30 gpm; springs south of Ferris Mtns flow up to 20 gpm • Transmissivity estimates from area east of Rock Springs uplift 168 to 560 gpd/ft • Permeabilities from area east of Rock Springs uplift from 21 to 62 gpd/ft² • TDS vary from 200 to > 60,000 mg/l
	Tertiary	North Park Formation	0-800	• Minor aquifer, supplies excellent quality spring water to Rawlins • Three wells yield 4 to 20 gpm • Transmissivity estimates from 2 pump tests: 150 and 1,000 gpd/ft • TDS generally < 500 mg/l
		Browns Park Formation	0-1,200	• Excellent aquifer with good interstitial permeability; possible saturated zone 870 ft thick • Well yields range from 3 to 30 gpm • Transmissivity estimates from 100 to 10,000 gpd/ft • Numerous springs maintain baseflow of streams south of the Rawlins area; one spring flows 343 gpm • TDS generally < 500 mg/l
		Bishop Conglomerate	0-200+	• Major aquifer in Rock Springs uplift area • Absence of thick, saturated zones limits well yields; one well yields 42 gpm • Good interstitial permeability
		Uinta/Bridger Formations (Washakie Form.)	0-3, 200+	• Relatively impremeable unit with only one questionably identified well and no spring data reported • Very low yields are expected
		Green River Formation (including Tipton, Wilkins Peak, and Laney members)	0-1, 500	• Laney Member wells yield up to 200 gpm; other members relatively impermeable and would produce low-yield wells • Laney transmissivity range 110 to 300 gpd/ft; permeability averages 10 gpd/ft² • TDS generally < 3,000 mg/l

Table 3-10. Hydrostratigraphy of Southwest and South-central Wyoming including the Great Divide and Washakie Basins, Continued.

Era	Period	Geologic Unit	Thickness (ft)	Hydrologic Properties
Cenozoic	Tertiary	Wasatch Formation	0-4, 000+	• Major aquifer; water-bearing sandstone lenses yield 5 to 250 gpm although most yield 30 to 50 gpm; possible yields of 500 gpm from thick, saturated sequences • Wells tapping the lower sands are artesian in some areas • Transmissivity estimates range from 150 to 10,000 gpd/ft • Porosity and permeability are 16 to 38 percent and 0.04 to 18.2 gpd/ft^2, respectively • TDS generally < 1,000 mg/l but some over 3,000 mg/l
		Battle Springs Formation	0-4, 700	• Major aquifer in eastern Great Divide Basin • Well yields range from 1 to 157 gpm • Transmissivity estimates from 29 to 3,157 gpd/ft • Porosity at one oil field was 15 to 25 percent • TDS generally < 1,000 mg/l
		Fort Union Formation	0-2, 700+	• Major aquifer, especially around border of basins; discontinuous, isolated water-bearing zones • Well yield ranges from 3 to 300 gpm • Transmissivity estimate generally < 2,500 gpd/ft • Porosity 15 to 39 percent • Permeability < 1 gpd/ft^2; permability largely fault-related on east side of Rock Springs uplift • TDS generally from 1,000 to 5,000 mg/l
Mesozoic	Upper Cretaceous	Lance Formation	0-4, 500+	• Minor aquifer, with well yields generally < 25 gpm • Transmissivity estimates generally < 20 gpd/ft, with some estimates up around 150 to 200 gpd/ft • Oil field porosity 12 to 26 percent • Oil field permeability 0.007 to 8.2 gpd/ft^2 • TDS generally from 1,000 to 5,000 mg/l
		Fox Hills Sandstone	0-400	• Minor aquifer • Well and spring yields not available • Porosity 20 percent • Transmissivity 10 to 20 gpd/ft • Permeability 0.9 gpd/ft^2

Table 3-10. Hydrostratigraphy of Southwest and South-central Wyoming including the Great Divide and Washakie Basins, Continued.

Era	Period	Geologic Unit	Thickness (ft)	Hydrologic Properties
Mesozoic	Upper Cretaceous	Lewis Shale	0-2, 700+	• Constricting layer mostly of impermeable shale but scattered sandstone lenses may be capable of yielding stock water supplies • Porosity ranges from 6 to 24 percent • Permeability ranges from 0.002 to 0.9 gpd/ft^2 • Transmissivity ranges from 0.03 to 50 gpd/ft
		Mesaverde Formation (includes Blair, Rock Springs, Ericson and Almond formations)	0-2, 2,800	• Major aquifer with maximum well yield of 470 gpm from Rock Springs Formation; most yield less than 100 gpm • Transmissivity estimates generally < 3,000 gpd/ft and much lower in the Almond Formation • Porosity ranges from 8 to 26 percent • Ericson Formation is best water source near Rock Springs uplift • TDS range from 500 to over 50,000 mg/l (below 1,000 mg/l only at outcrops)
		Baxter Shale (includes Cody and Steele shales and Niobrara Form.)	2,000-5,000+	• Major regional constricting layer throughout area west of Rawlins uplift • Thin sandstone beds may yield small quantities of water, but high TDS concentrations likely
		Frontier Formation	190-900+	• Productive aquifer; yields range from 1 to > 100 gpm • Transmissivity estimates 15,000 to 20,000 gpd/ft for water well pump tests; however, generally < 100 gpd/ft for drill stem tests, with maximum of 6,500 gpd/ft • TDS range from 500 to 60,000 mg/l (<1,500 mg/l in near outcrops)
	Lower Cretaceous	Mowry Shale	150-525	• Regional constricting layer; well and spring data not available
		Thermopolis Shale (includes Muddy Sandstone Member)	20-235	• Leaky confining unit; water produces from Muddy Sandstone Member in northeast Great Divide Basin • Well and spring data not available
		Cloverly Formation	45-240	• Major aquifer which crops out on Rawlins uplift; deeply buried over most of area • Well yields range from 25 to > 120 gpm • Transmissivity estimates range from 1 to 1,700 gpd/ft (combined water well and drill stem) • TDS range from 200 to 60,000 mg/l (<1,500 mg/l in near outcrops)

Table 3-10. Hydrostratigraphy of Southwest and South-central Wyoming including the Great Divide and Washakie Basins, Continued.

Era	Period	Geologic Unit	Thickness (ft)	Hydrologic Properties
Mesozoic	Upper Jurassic	Morrison Formation	170-450+	• Confining unit • Well and spring data not available
		Sundance Formation	130-450+	• Artesian flow to several wells in Rawlins area • Well yields between 27 and 35 gpm • Transmissivity ranges from 12 to 3,500 gpd/ft • TDS range from 1,100 to 40,000 mg/l (<1,500 mg/l in near outcrops)
	Lower Jurassic-Upper Triassic	Nugget Sandstone	0-650+	• Well yield data limited but range from 35 to 200 gpm • Maximum transmissivity from drill stem tests 2,166 gpd/ft • TDS range from 1,100 to 40,000 mg/l (<1,500 mg/l in near outcrops)
	Triassic	Chugwater Formation	900-1,500+	• Confining unit; hydrologic data not available
Mesozoic/ Paleozoic	Lower Triassic-Permian	Phosphoria Formation	170-460	• Water-bearing capabilities poorly known; probably poor due to low permeability of rock units • TDS generally between 5,000 to 10,000 mg/l
Paleozoic	Permian-Pennsylvanian	Tensleep Formation	0-840+	• Important water-bearing zone; well yields range from 24 to 400 gpm • One spring flows 200 gpm in Rawlins area • Transmissivity generally low, range 1 to 374 gpd/ft • TDS generally > 3,000 mg/l
	Lower and Middle Pennsylvanian	Amsden Formation	0-260+	• Hydrologic data not available; unit probably has poor water-bearing potential due to predominance of fine-grained sediments • TDS generally > 10,000 mg/l
	Mississippian	Madison Limestone	5-325+	• Major aquifer; excellent secondary permeability development due to solution channeling, caverns, and fractures • Well yields up to 400 gpm • Transmissivities highly variable • TDS range from 1,000 to >10,000 mg/l
	Cambrian	Undifferentiated	0-800+	• Major water-bearing zone, especially near Rawlins • Well yields between 4 and 250 gpm • Transmissivity data are suspect • TDS generally <1,000 mg/l but some areas with 5,000 to 10,000 mg/l

Table 3-10. Hydrostratigraphy of Southwest and South-central Wyoming including the Great Divide and Washakie Basins, Continued.

Era	Period	Geologic Unit	Thickness (ft)	Hydrologic Properties
Precambrian			unknown	• Frequently used aquifer in northwestern corner of Great Divide Basin near South Pass City • Well yields typically range from 10 to 20 gpm • Reported transmissivities are < 1,000 gpd/ft • Generally high permeability in fractured and weathered zone in upper 200 ft of unit

[1] Adapted from Collentine et al. (1981); additional sources include Lowham et al. (1985), Heath (1984), and Freethey (1987).

3.4.3.2 Quality

Groundwater quality is related to the depth of the aquifers and the rock type. Groundwater quality is variable in the GWA II analysis area. Total dissolved solids concentration (TDS), an indicator of salinity, is generally less than 1,000 mg/l (considered fresh), but in some areas may be greater than 2,000 mg/l (slightly saline to saline). The TDS is usually higher when the aquifer is interbedded with lake deposits that contain evaporite minerals. Dissolved ions are primarily calcium, sodium, and bicarbonate. Shallow waters from all members of the Tertiary aquifer system generally have <3,000 mg/l TDS. A spring 12 miles east of the GWAA had 57,000 mg/l TDS (briny) (Sec. 3 T18N R90W). The Battle Springs and Wasatch formations typically contain less than <1,000 mg/l TDS, with calcium, sodium, sulfate, and bicarbonate the predominant ions.

The quality of water emanating from surface springs can provide an indication of the quality of groundwater source. Lowham et al. (1985) indicate that dissolved solids concentration from Echo Springs ranged from 1,000 to 3,000 mg/l. Creston Creek had greater than 3,000 mg/l. An unnamed creek near Highway 30 between Latham and Wamsutter had between 500 and 1,000 mg/l. Along Separation Creek to the east of the project area, concentrations of dissolved solids ranged from 500 to over 3,000 mg/l. Most samples were between 500 to 1,000 mg/l. As a means of comparison, groundwater with dissolved concentrations of less than 5,000 mg/l is generally suitable for livestock.

Concentrations of several ions of groundwater in the GWA II area exceeded drinking water standards (Collentine et al. 1981) based on water quality listed in WDEQ (1990). Fluoride concentration in a sample from the Laney Member of the Green River Formation southwest of Wamsutter was 2.3 mg/l. Fluoride concentration in the Quaternary alluvium, Wasatch Formation, and Mesaverde Group ranged from 2.3 to 7.9 mg/l. Exceedances for primary drinking water standards have been recorded for chromium within the Wasatch Formation (Sec. 25, T23N R96W), Frontier Formation (Sec. 15, T13N R87W), and Cambrian aquifer (Sec. 10 T21N R87W); for lead in the Fort Union Formation (Sec. 11 T21N R89W) and Frontier Formation (Sec. 15 T13N R87W); and for cadmium in the Almond Formation (Sec. 27 T13N R90W). Few water sources in the area meet the secondary drinking water standards for sulfate, chloride, or TDS. However, Driver et al. (1984) indicate that trace elements are generally below standards for drinking water within the Washakie Basin. Selenium problems are local in nature. Water quality is generally sufficient for oil and gas well drilling.

The confining beds slow the movement of water, and hence, movement of potential contaminants between aquifers. Although there is some downward movement of the water from the surface units, most of the groundwater movement, if any, is upward from the deeper aquifers to the shallower aquifers. Concerns have been raised for several gas field projects in southwest Wyoming regarding groundwater quality degradation due to the piercing of confining layers and vertical and horizontal migration and mixing of water of variable qualities. Data suggesting this is a current problem in the GWA II analysis area are not available. Improperly completed injection wells could be a potential source of contamination.

3.4.3.3 Development/Use of Groundwater Resources

The majority of the groundwater in the vicinity of the GWA II area is obtained from Tertiary units. Total estimated use in both basins is between 80,000 to 89,000 acre-feet/year (Collentine et al. 1981). Table 3-11 shows the relative amount of groundwater use in the general vicinity of the GWA II analysis area. Industry uses 46,000 ac-ft/yr (25,000 ac-ft/yr for power plant cooling and 21,000 ac-ft/yr evenly divided between petroleum, coal, and uranium industries). Agriculture uses from 31,000 to 39,000 ac-ft/yr for irrigation and stock watering. Domestic use is 3,000 to 3,600 ac-ft/yr.

Regional groundwater development has been negligible but locally has affected some aquifers. For example, water levels for the Mesaverde Group as measured near Rock Springs, Wyoming between 1946 to 1986 have declined and more-or-less "stabilized." Water level changes have ranged from nearly +2 feet to approximately -3.2 feet (Freethey 1987).

Table 3-11. Summary of Approximate Water Use in the GWA II Analysis Area[1].

Economic Sector	Total (%)	Groundwater (%)	Surface Water (%)
Industry	55	87	41
Agriculture	41	8	55
Drinking Water	4	5	4

[1] Source: Collentine et al. (1981).

3.5 VEGETATION AND WETLANDS

3.5.1 General Vegetation

Vegetation in the analysis area is typical of the semi-arid Wyoming Basin floristic region, where precipitation and soil parent material are controlling factors for plant composition. Vegetation often appears sparse. Ten cover types are present in the analysis area: mixed desert shrub, barren land/cushion plant, urban land, disturbed land, marsh, saline subirrigated meadow, mudflat/playa, aquatic bed, open water, and riverine. Detailed descriptions of each are presented in the Vegetation and Wetlands Technical Report (ECOTONE 1995b) prepared for this EIS and on file with the BLM Rawlins District Office.

In upland areas, groundcover is primarily comprised of drought-tolerant shrubs and grasses. Typical species include sagebrush (*Artemisia* spp.), rabbitbrush (*Chrysothamnus* spp.), saltbush (*Atriplex* spp.), spiny horsebrush (*Tetradymia spinescens*), and greasewood (*Sarcobatus vermiculatus*). Intershrub areas have sparse cover (15 percent) of Indian ricegrass (*Oryzopsis hymenoides*), wheatgrass (*Agropyron* spp.), Sandberg bluegrass (*Poa secunda*), and bottlebrush squirreltail (*Sitanion hystrix*). Species composition varies according to soil texture. Sagebrush dominates in less saline or alkaline soils. Spiny shrubs such as greasewood and saltbush dominate in medium to heavy textured saline or alkaline soils. Total groundcover ranges from 15 to 65 percent.

Along drainages and topographically lower areas, species tolerant of higher alkalinity and/or increased moisture grow. Such species include greasewood, poverty sumpweed (*Iva axillaris*), foxtail barley (*Hordeum jubatum*), thickspike wheatgrass (*Agropyron dasystachyum*), mat muhly (*Muhlenbergia richardsonis*), western wheatgrass (*A. smithii*), Nuttall's alkaligrass (*Puccinellia nuttalliana*), and creeping spikerush (*Eleocharis palustris*). Groundcover varies from 35 to 85 percent. As described in the following section, some lowland area cover types qualify as jurisdictional wetlands.

Weeds occur throughout the project area at varying densities and frequencies. More weeds occur on and around areas that have been disturbed (by humans or animals), such as along or near roads, highways, drill sites, livestock watering areas, etc. The State of Wyoming has identified 20 noxious weeds (Table 3-12); however, not all may occur in every county. In addition to these species, Sweetwater County adds foxtail barley and Carbon County includes Geyer larkspur (*Delphinium geyeri*) (Sweetwater County Weed & Pest District 1994, Carbon County Weed & Pest District 1994).

The most common poisonous plants within the project area are halogeton (*Halogeton glomeratus*), milkvetch (*Astragalus* spp.) and locoweed (*Oxytropis* spp.). Other poisonous plants include larkspur (*Delphinium* spp.), horsebrush, greasewood, deathcamas (*Zigadenus* spp.), arrowgrass (*Triglochin maritimum*), tansy mustard (*Descurainia pinnata*), and cocklebur (*Xanthium* spp.). Most of these plants occur in the mixed desert shrub cover type; some occur in wet places.

3.5.2 Waters of the United States, Including Wetlands

Waters of the United States, including special aquatic sites and wetlands, represent unique and important resources within the project area. The Corps of Engineers (COE), through the CWA Section 404(b)(1) guidelines and permitting process, has the administrative authority to regulate activities that involve excavation of or discharge of dredge/fill material into waters of the U.S. To be subject to regulation (i.e., jurisdiction) under the federal program, a wetland must have hydrophytic plants, hydric soils, and surface or subsurface water to support such plants and soils. Other administrative directives that involve wetlands protection on federally administered land include Executive Orders 11990 (wetland protection) and 11988 (floodplain protection).

Because of the large size of the GWA II analysis area, the great detailed of field evaluation needed to accurately identify and delineate wetlands, and the fact that site-specific locations of project features were not identified for this EIS, potential wetland areas were initially identified using National Wetlands Inventory (NWI) maps produced by the U.S. Fish and Wildlife Service (FWS). Most identified areas were small and scattered widely throughout the analysis area

Table 3-12. Designated Noxious Weeds in Wyoming[1].

Scientific Name	Common Name
Agropyron repens	Quackgrass
Arctium minus	Common burdock
Cardaria draba, C. pubescens	Hoary cress, whitetop
Carduus acanthoides	Plumeless thistle
Carduus nutans	Musk thistle
Centaurea diffusa	Diffuse knapweed
Centaurea maculosa	Spotted knapweed
Centaurea repens	Russian knapweed
Chrysanthemum leucanthemum	Ox-eye daisy
Cirsium arvense	Canada thistle
Convolvulus arvensis	Field bindweed
Cynoglossum officinale	Houndstongue
Euphorbia esula	Leafy spurge
Fraseria discolor	Skeletonleaf bursage
Isatis tinctoria	Dyers woad
Lepidium latifolium	Perennial pepperweed
Linaria dalmatica	Dalmatian toadflax
Linaria vulgaris	Yellow toadflax
Onopordum acanthium	Scotch thistle
Sonchus arvensis	Perennial sowthistle

[1] Sources: Sweetwater County Weed and Pest District, 1994; Carbon County Weed and Pest District, 1994.

(Exhibit 3-3). These maps only indicate the potential occurrence and distribution of jurisdictional wetlands because 1) the scale of resolution is small (i.e., 1:24,000); 2) a different method was used to identify wetlands for the NWI maps than for the 1987 COE manual (Environmental Laboratory 1987), and 3) very little ground truth verification of the NWI maps occurred. Approximately 70 sample points were located in various wetland areas in the GWA II area to gather three-parameter data required to identify and delineate jurisdictional wetlands during the summer of 1994 (ECOTONE 1995b). Wetland investigations were performed in support of, but do not replace, site-specific jurisdictional wetland inventories necessary for CWA 404(b)(1) compliance. The NWI maps provided a fairly accurate indication of the presence of wetlands but did not accurately depict true boundaries between uplands and wetlands as described in the Vegetation and Wetlands Technical Report (ECOTONE 1995b).

Of the ten cover types previously described, six are aquatic habitats: marsh, saline subirrigated meadow, mudflat/playa, aquatic bed, open water, and riverine. Table 3-13 classifies each according to size and the permanence of water. Within the project area, the condition of these aquatic habitats is highly variable. Therefore, descriptions of these aquatic habitats, as presented in the Vegetation and Wetlands Technical Report (ECOTONE 1995b), represent arbitrary boundaries along a continuum.

Wetlands have gained considerable recognition for their value in maintaining biological, physical, and socioeconomic systems. The functions wetlands perform include groundwater discharge and recharge, flood storage and desynchronization, shoreline anchoring and dissipation of erosive forces, sediment trapping, nutrient retention and removal, food chain support, wildlife and fish habitat, and heritage values including active and passive recreation and socioeconomic qualities or benefits (aesthetics; education; recreation, consumptive and non-consumptive; non-consumptive-societal; and global processes) (Adamus and Stockwell 1983).

Professional judgement for determining the functional values of wetlands within the project area was guided by Adamus (1983), Adamus and Stockwell (1983), and Adamus et al. (1987). Values were assigned for each wetland or special aquatic site cover type (Table 3-14). Values inherently incorporate differences created by the dissimilarity in cover type vegetation height, condition, and hydroperiod. ECOTONE (1995b) discusses each functional value relative to wetlands in the analysis area.

3.5.3 Extent of Coverage

The mixed desert shrub cover type dominates the analysis area (approximately 254,430 acres). The barren/cushion plant cover type covers 63,608 acres. Urban land (including roads, railroad, residential and commercial buildings) comprises 6,231 acres. Disturbed land (6,296 acres) is

Table 3-13. Classification of Aquatic Habitats within the GWA II Analysis Area.[1]

Aquatic Habitat	Cowardin Classification[1]
Marsh	Palustrine Emergent Persistent Semipermanently Flooded
Saline Subirrigated Meadow	Palustrine Emergent Persistent Seasonally/ Temporarily Flooded; Palustrine Unconsolidated Shore Temporarily/Seasonally/Semipermanently Flooded
Mudflat/Playa	Palustrine Unconsolidated Bottom Temporarily Flooded
Aquatic Bed	Palustrine Aquatic Bed Seasonally/ Semipermanently Flooded; Lacustrine Littoral Aquatic Bed Intermittently Exposed
Open Water	Palustrine Unconsolidated Shore Seasonally/Semipermanently Flooded; Palustrine Unconsolidated Bottom Temporarily/Semipermanently Flooded; Lacustrine Littoral Unconsolidated Shore Temporarily Flooded
Riverine	Riverine Intermittent Streambed Temporarily Flooded

[1] Source: Cowardin et al. (1979).

Table 3-14. Estimated Functional Values for Aquatic Habitats within the GWA II Analysis Area.

Aquatic Habitat	Function[1]								
	GWR	GWD	FSD	SAD	SED	NRR	FCS	HAB	REC
Marsh	+	+	o	o	o	+	+	x	x
Saline Subirrigated Meadow	x	x	x	x	x	x	x	x	x
Mudflat/Playa	x	o	o/x	o	+	x/+	x	x	o
Aquatic Bed	+	o	x	o	+	+	x	x	x
Open Water	+	x	x	o	x	+	+	x	x
Riverine	+	x	o	o	x	x	x	+	x

\+ - major functional value
x - minor functional value
o - no or minimal functional value

1 - Wetland and Special Aquatic Site Functions (Adamus and Stockwell 1983):
GWR = groundwater recharge
GWD = groundwater discharge
FSD = flood storage and desynchronization
SAD = shoreline anchoring and dissipation of erosive forces
SED = sediment trapping
NRR = nutrient retention and removal
FCS = food chain support
HAB = wildlife and fish habitat
REC = active and passive recreation and heritage value

comprised of pipelines, existing drill and well sites, and other facilities. The primary wetland cover type, saline subirrigated meadow (2,069 acres), occurs in areas of internal drainage as well as scattered along ephemeral channels where soil saturation occurs for a sufficient length of time to support more hydrophytic (i.e., water-loving) species. There is a minor amount of marsh (7 acres). Other aquatic habitats include mudflat/playa (748 acres), open water and aquatic bed (612 acres), and riverine (190 acres). Coverage by wet meadow, marsh, open water/aquatic bed, and mudflat/playa is not exact due to the high variability of environmental conditions that allow shifts from one type to another over the course of the growing season.

3.5.4 Plant Species of Concern

Plant species of concern include species listed as threatened or endangered under the federal Endangered Species Act of 1973 (ESA), species proposed for listing, candidate species under consideration for listing, and other species of concern to the BLM and Wyoming Natural Diversity Database (WYNDD). Updated inquiries to the WYNDD and the FWS reveal no known threatened or endangered plants within the analysis area (USDI-FWS 1994; WYNDD 1994) or a township buffer. However, there were records for four sensitive species: broad-flowered pincushion (*Chaenactis stevioides*), contracted ricegrass (*Oryzopsis contracta*), an unnamed tiny phacelia (*Phacelia tetramera*), and western hop-sage (*Zuckia brandegei*). The BLM has six additional species of concern: diffuse sagebrush (*Artemisia biennis diffusa*), Cedar Rim thistle (*Cirsium aridum*), Wyoming tansy mustard (*Descurainia torulosa*), large-fruited bladderpod (*Lesquerella macrocarpa*), Gibbens penstemon (*Penstemon gibbensii*), and Opal phlox (*Phlox opalensis*). Table 3-15 summarizes status and habitat data for these ten species.

Contracted ricegrass, which is being recommended for downlisting to 3C status (Amidon 1994), has been located on Delaney Rim as well as in several locations within the analysis area. The other species occur in adjacent areas or prefer habitats similar to those found within the analysis area; therefore, they have potential to occur in the project area. Habitats for these species were examined during fieldwork accomplished in June 1994. The likelihood of occurrence ranges from low to moderate. Delaney Rim has high potential for plant species of concern. The Vegetation and Wetlands Technical Report discusses each species of concern in detail.

Three additional species indicated by the BLM, Rawlins District, include Ownbey's thistle (*Cirsium ownbeyi*); stemless beardtongue (*Penstemon acaulis* var. *acaulis*); and Green River greenthread (*Thelesperma caespitosum*). Based on consultation with the FWS and the WYNDD search, none of these plants are known to occur within a township buffer around the project area.

Table 3-15. Plant Species of Concern, Status (including BLM Special Status Plants), and Habitat Characteristics.

Scientific Name	Common Name	Status[2]	Habitat	Probability of Occurrence[3]
Artemisia biennis var. diffusa	Diffuse sagebrush	C2, G5T1, S1, BLM, WYLST 1	clay flats and playas in Sweetwater County, 6,500 ft. Associated vegetation: *Hordeum jubatum* and *Chenopodium glaucum*	possible
Chaenactis stevoides	Broad-flowered pincushion	G3?, S1, WYLST 2	sandy desert areas, 6,000-6,800 ft. Associated vegetation: *Sarcobatus vermiculatus* and *Grayia spinosa*	possible
Cirsium aridum	Cedar Rim thistle	C2, G1, S1, BLM, WYLST 1	barren, chalky hills, silty banks; 6,700-7,100 ft. Associated vegetation: *Phlox bryoides, Astragalus kentrophyta, A. spatulatus, Linum kingii, Eriogonum divaricatum, Leptodactylon* spp., and *Oryzopsis* spp.	likely
Cirsium ownbeyi	Ownbey's thistle	C2, G3, S1, RS-BLM, WYLST 1	sagebrush grasslands in and near Flaming Gorge National Recreation Area, 5,500-6,200 ft. Associated vegetation: unknown	unlikely
Descurainia torulosa	Wyoming tansy mustard	C2, G1, S1, RS-BLM, WYLST 1	volcanic scree or very sandy soil at base of north-facing sandstone cliffs, rock crevices, loose talus slopes, 7,600-10,900 ft. Associated vegetation: no strict associates known; *Pseudotsuga menziesii*? and *Populus tremuloides*?	unlikely
Lesquerella macrocarpa	Large-fruited bladderpod	C2, G2, S2, RS-BLM, WYLST 1	sparsely vegetated, loose clay soils of flats, slopes, and hills; 7,000-7,800 ft. Associated vegetation: *Atriplex gardneri, Sitanion hystrix, Phlox bryoides, Cymopterus* spp., and *Lomatium* spp.	possible
Oryzopsis contracta	Contracted Indian ricegrass	C2, G2, S2, RWL-BLM, WYLST 1	plains and hills of western ¾ of state, 6,000 ft. Associated vegetation: *Artemisia tridentata, Atriplex* spp., and *Opuntia polyacantha*	likely
Penstemon acaulis var. acaulis	Stemless beardtongue	C2, G3, S1, RS-BLM, WYLST 1	sparsely vegetated, rocky, gravelly hills and ridges and slopes in southern Sweetwater County; 5,000-7,200 ft. Associated vegetation: *Arenaria hookeri, Lesquerella alpina*, and *Phlox* spp.	unlikely
Penstemon gibbensii	Gibbens penstemon	C2, G1, S1, BLM, WYLST 1	sandy or shaley (often Green River Shale) bluffs and slopes, 5,500-7,500 ft. Associated vegetation: *Juniperus* spp., *Cirsium* spp., *Eriogonum* spp., *Elymus* spp., *Amelanchier alnifolia, Chrysothamnus* spp., *Thermopsis* spp., *Arenaria* spp., and *Astragalus* spp.	possible
Phacelia tetramera	Tiny phacelia	G4, S1, WYLST 2	sand dune by drainage, heavy soils of bottomlands, 4,400-7,200 ft. Associated vegetation: *Artemisia tridentata, Sarcobatus vermiculatus, Allenrolfea occidentalis*	possible
Phlox opalensis	Opal phlox	C2, G1, S1, BLM, WYLST 1	semibarren desert grassland on clay and clay-derived soils, 6,300-7,000 ft. Associated vegetation: *Artemisia pedatifida, Eriogonum* spp., *Arenaria hookeri, Atriplex gardneri, Sphaeromeria argentea*	possible

Table 3-15. Plant Species of Concern, Status (including BLM Special Status Plants), and Habitat Characteristics, Continued.

Scientific Name	Common Name	Status[2]	Habitat	Probability of Occurrence[3]
Thelesperma caespitosum	Green River greenthread	C2, G1?, S1, RS-BLM, WYLST 1	rocky ridges. Associated vegetation: unknown	unlikely
Zuckia brandegei	Western hop-sage	G4, S2, WYLST 3	silt loam soils on crumbling shale outcrops in draws, clay soil on north-facing slope with high bluffs, "badlands," 6,800-7,200 ft. Associated vegetation: *Artemisia tridentata* and *Sarcobatus vermiculatus*	likely

[1] - Source: Neighbours (1994), Davis (1994), Weynand and Amidon (1990), Fertig (1993), Clark and Dorn (1979).

[2] - Definition of status

Federal Status

E Federally Listed Endangered. Species, subspecies, or populations that are threatened with extirpation or extinction resulting from very low or declining numbers, alteration and/or reduction of habitat, detrimental environmental changes, or any combination of the above. Continued long-term survival is unlikely without implementation of special measures.
T Federally Listed Threatened. Species likely to become endangered in the foreseeable future throughout all or a significant portion of its range.
P Federally Proposed for Listing. Species that are proposed for listing as threatened or endangered.
C1 Federal Category 1 Candidate species. Species for which there is substantial information on file on the biological vulnerability and threats to support the appropriateness of proposing to list taxa as an endangered or threatened species.
C2 Federal Category 2 Candidate species. Species for which there is some evidence of vulnerability but for which there are insufficient data to support listing and for which additional study is needed.
3C Federal Category 3C Candidate species. Species that have been found to be more abundant or widespread than had been previously believed, and/or those that are not subject to identifiable threats that place the continued existence of the species at risk.

Global Rank/Definition

G1 Critically imperilled globally because of extreme rarity (5 or fewer occurrences or very few remaining individuals) or because of some factor of its biology that makes it especially vulnerable to extinction (Critically endangered throughout range).
G2 Imperiled globally because of rarity (6 to 20 occurrences) or because of other factors demonstrably making it very vulnerable to extinction throughout its range (Endangered throughout range).
G3 Either very rare and local throughout its range or found locally (even abundant at some of its locations) in a restricted range, or because of other factors making it vulnerable to extinction throughout its range (21 to 100 occurrences; Threatened throughout its range).
G4 Apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery.
G5 Demonstrably secure globally, though it may be quire rare in parts of its range, especially at the periphery.

State Rank

S1 Critically imperiled in Wyoming because of extreme rarity (five or fewer occurrence, or very few remaining individuals) or because of some factor of its biology making it especially vulnerable to extinction (Critically endangered in state).
S2 Imperiled in Wyoming because of rarity (6 to 20 occurrences) or because of other factors demonstrably making it very vulnerable to extinction throughout its range (Endangered in state).
S3 Rare in Wyoming (on the order of 20+ occurrences) (Threatened in state).
S4 Apparently secure in Wyoming.
S5 Demonstrably secure in Wyoming.

Other Codes

T Rank for a subspecific taxon (species or variety); appended to the global rank for the full species.
? Assigned status questionable.
RWL Recommended for the Watch List for a given resource area of the Bureau of Land Management (PRRA - Platte River Resource Area).
RS Recommended for Federal Sensitive designation.
BLM BLM-identified Special Status plants

Wyoming Natural Diversity Data Base

WYLST 1 Highest priority
WYLST 2 Medium priority
WYLST 3 Lowest priority

[3] - Probability based on presence of habitat and known distribution.

3.6 RANGE RESOURCES AND OTHER LAND USES

3.6.1 Range Resources

The majority of the GWA II analysis area was analyzed in the GWA EA (USDI-BLM 1992a). An additional 60 sections of land (38,400 acres) is included in the GWA II EIS range analysis.

There are 15 grazing allotments in the GWA II analysis area and 14 grazing permits. Five of the allotments are for cattle and horses, four are for cattle and sheep, three are for cattle only, and two are for sheep only.

All of these allotments are fenced except for the northern boundary of allotment 10722 (north side of the GWA II analysis area). All or part of these allotments are within the analysis area. All grazing allotments are fenced, and pasture division fences exist within the allotments, but these fences do not necessarily coincide with the GWA II analysis area boundaries. Most of the sheep grazing is overseen by herders, while use by cattle and horses is generally regulated by fences.

Livestock carrying capacities within the GWA II analysis area typically range from six to 20 acres per animal unit month (AUM). Many of the operators voluntarily reduce their stocking rates during years of low forage productivity.

Cattle grazing accounts for about 71 percent of the total grazing use (including yearling operations which make up 2 percent of the total). Sheep grazing constitutes about 28 percent of the use and horse use results in about one percent of the grazing. See Table 3-16 for a summary of grazing use for the past year.

Table 3-16. Monthly Livestock Use During 1993 in the GWA II Analysis Area.

	Monthly Livestock Use (in percentages)												Total Use %
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Cattle	3	3	3	9	14	13	12	12	12	9	7	3	**100**
Sheep	15	15	17	12	3	3	2	2	2	2	12	15	**100**
Annual Use	6	6	7	10	11	11	9	9	9	7	8	7	**100**

The figures in Table 3-16 illustrate that the GWA II analysis area provides grazing for livestock consistently throughout the year varying from a low of six percent in January and February, to a high of 11 percent during May and June. Most of the cattle grazing occurs during the spring and summer months, coinciding with current growth of herbaceous plants. Sheep grazing is greatest during the fall and winter months, when sheep depend to a greater extent on shrubby forage.

Permitted horse use during each month of the year, varies from 23 to 28 AUM's per month. Feral horses are found within the GWA II, most of which are south of the Interstate Highway. Some of the feral horses north of the Interstate are scheduled to be removed during 1994 and some of those south of the Interstate are scheduled to be removed or relocated by the end of 1995.

Range improvements are scattered throughout the analysis area. Review of currently existing range improvement permits and cooperative agreements in the GWA II analysis area shows a total of 117 range improvements on file with the BLM. The majority of the improvements (72) are water development permits. In addition, there are 29 fence permits and 16 other improvements which include raptor nests and a variety of other developments.

3.6.2 Other Land Uses

The Great Divide Resource Area right-of-way (ROW) records show that the GWA II analysis area has considerable surface use activity, most of which is related to oil and gas exploration and development. Of the 964 existing ROWs currently on record (USDI-BLM 1992a), 50 percent are oil and gas pipelines, and 28 percent are roads. Other ROWs include powerline (8 percent) and telephone and telegraph (6 percent). The remaining ROWs (8 percent) pertain to federal and county highways, material sites, railroads, communication sites, water, and salt water disposal sites. Also, the community of Wamsutter lies within the GWA II analysis area. In addition, there are at least 35 isolated habitations or other human-use structures scattered within the analysis area boundaries.

3.7 WILDLIFE

3.7.1 Introduction

The Greater Wamsutter Area II (GWA II analysis area) is contained within the Bureau of Land Management (BLM) Great Divide Resource Area. The Great Divide Resource Management Plan (USDI-BLM 1990a) provides for sustained multiple use management of the public lands and resources and is used to resolve planning issues. Information concerning historical wildlife usage of the GWA II analysis area was obtained through the BLM Great Divide Resource Area District Office in Rawlins, Wyoming. Specifically, historical locations for sage grouse leks, raptor nests, and prairie dog colonies were obtained through this agency with the assistance of the BLM Biologist (prairie dog locations can be seen in the wildlife technical report, HWA 1994a). The

Wyoming Game and Fish Department (WGFD) maintains a computerized listing of all wildlife species reported in an area. This listing, known as the Wildlife Observation System (WOS) was accessed for information concerning all species of wildlife including waterfowl, shorebirds, songbirds, all mammal species, amphibians, and reptiles. Sage grouse activity records, seasonal big game range designations, and herd unit annual reports were also provided by the WGFD. The GWA II analysis area is contained within WGFD Districts 4 and 6. WGFD biologists were interviewed for additional information concerning wildlife in the area. The Nature Conservancy, a private international conservation organization which focuses on preservation of natural diversity, supports a nation-wide network of state Natural Heritage programs which maintain computerized files on plants and animals of special concern. The Wyoming Natural Diversity Database (WYNDD) did not contain any recently reported observations of threatened or endangered species within the GWA II analysis area.

Existing wildlife information for the GWA II analysis area was supplemented through the collection of survey data in 1994 conducted by HWA. These data collections consisted of aerial surveys to locate active sage grouse leks, and ground surveys to: 1) verify sage grouse lek locations and attendance, 2) determine occurrence of threatened, endangered, and candidate species as listed for the GWA II analysis area by the FWS (USDI-FWS 1994), and 3) determine white-tailed prairie dog colony boundaries, acreages, and burrow densities.
Details of these surveys are presented in a separate technical report (HWA 1994a).

3.7.2 Wildlife Habitats

Four primary wildlife habitat types occur within the affected area. These habitat types correspond with the vegetation community types described in detail in the Vegetation Section (Section 3.5) of this document and include: alkaline mixed desert shrub, sagebrush mixed desert shrub, riparian/wetlands, and barren lands.

The alkaline mixed desert shrub habitat is dominated by widely-spaced, low-growing shrubs such as spiny hopsage, rabbitbrush, saltbush, and pricklypear cactus. Greasewood occurs in areas with higher moisture, such as valley bottoms.

The sagebrush mixed desert shrub is dominated by numerous sagebrush species including Wyoming big sagebrush, basin big sagebrush, and birdfoot sagebrush. The sagebrush height varies from one to six feet, depending on moisture availability with the tallest vegetation located in drainage bottoms.

The riparian zones and wetlands occur along creek bottoms and major washes. Small stock-pond impoundments and reservoirs occur on the project area and serve as migration stop-over habitat for some waterfowl, shorebird, and wading species. Since these ponds are frequented by livestock, emergent vegetation is noticeably sparse and they do not provide good waterfowl brood-rearing habitat. The only major water course, Muddy Creek (two miles southeast of GWA II analysis area), is perennial with heavier flows during spring run-off and following summer thundershowers.

Rock outcrops, active sand dunes, and cliff areas are included in the barren habitat type. These habitats are usually void of vegetation and are often elevated from the surrounding prairie, providing excellent raptor nesting sites.

3.7.3 Threatened and Endangered Wildlife Species

The FWS has determined that four species, listed as either threatened or endangered by the Endangered Species Act of 1973 (ESA), as amended, are potentially present in the project area (USDI-FWS 1994; Appendix A). The four threatened or endangered species and their federal status under the ESA that may occur on or adjacent to the project area are shown in Table 3-17.

These species are addressed in more detail in the document entitled Biological Assessment of Threatened, Endangered, and Candidate Species for the Greater Wamsutter Area II prepared by Hayden-Wing Associates (1994b), which is incorporated into this EIS by reference.

3.7.3.1 Black-footed Ferret

White-tailed prairie dog (*Cynomys leucurus*) colonies provide essential habitat for black-footed ferrets. Ferrets depend on prairie dogs for food and they use prairie dog burrows for shelter and raising their young (Hillman and Clark 1980, Fagerstone 1987). Since ferrets are nocturnal and spend much of their time underground, their presence in an area is difficult to confirm but their original distribution in North America closely corresponded to distribution of prairie dogs (Hall and Kelson 1959, Fagerstone 1987).

Data collected during 1992 and 1994 surveys, and illustrated in Exhibit 3-4, indicates that a total of 106 white-tailed prairie dog colonies cover nearly two percent of the 334,191-acre analysis area (HWA 1992, 1994a). These colonies vary in size from 0.3 to 1,113 acres, average 61.1 acres in size, and occur in the southern two-thirds of the analysis area (Exhibit 3-4). White-tailed prairie dog colonies with burrow densities of eight or more per acre, and greater than 200 acres in size, are considered to be potential ferret habitat and must be surveyed for ferret sign and cleared prior to construction activities. FWS guidelines also require the consideration of prairie dog complexes. A complex consists of two or more neighboring prairie dog towns, with burrow densities of eight or more per acre, that are less than 4.34 miles apart. Collectively, 30 of these colonies constitute a prairie dog complex that covers most of the southern portion of GWA II analysis area.

During the 1992 and 1994 surveys, burrow mounds within a colony were visually inspected for signs of ferret trenching, ferret remains, ferret scat, and remains of prairie dogs consumed by mustelids, as described by Henderson et al. 1969, Fortenbery 1972, Clark et al. 1983, and Forrest et al. 1985. Although apparently suitable habitat for ferrets exists on the analysis area and several unidentified scats were found and analyzed, no conclusive evidence of ferret presence was found.

Table 3-17. Threatened or Endangered Species Potentially Present in the GWA II Analysis Area.

Species	Scientific Name	Status
Mammals		
Black-footed ferret	*Mustela nigripes*	Endangered
Birds		
Bald eagle	*Haliaeetus leucocephalus*	Endangered
Peregrine falcon	*Falco peregrinus*	Endangered
Whooping crane	*Grus americana*	Endangered

Two black-footed ferret sightings have been reported on the GWA II analysis area since 1978. One 'probable' sighting, reported in 1978, was three to four miles south of the town of Wamsutter (Jobman and Anderson 1981). More recently, a 'probable' sighting was reported on September 3, 1989, near Government Reservoir, in Sec 14, T18N R93W (USDI-FWS 1991). In addition, from 1971 through 1991, twelve sightings of black-footed ferrets were reported within a 30-mile radius of the study site. Of these, five of the sightings have been listed as 'confirmed' reports, while the remaining are listed as 'probable.'

For more details see the wildlife technical report for the Greater Wamsutter Area II (HWA 1994a), and the Biological Assessment of Threatened, Endangered, and Candidate Species for the Greater Wamsutter Area II (HWA 1994b).

3.7.3.2 Bald Eagle

Bald eagles typically build stick nests in the tops of coniferous or deciduous trees along streams, rivers or lakes; they may also select cliffs and ledges as nest substrates (Call 1978). Selection of nest trees appears to depend, in part, on food availability early in the nesting season (Swenson et al. 1986). Primary wintering areas are typically associated with concentrations of food sources along major rivers that remain unfrozen where fish and waterfowl are available and near ungulate winter ranges (Montana Bald Eagle Working Group 1990). Wintering bald eagles are known to roost near concentrations of domestic sheep and big game in forests with large, open conifers and snags often protected from winds by ridges (Anderson and Patterson 1988).

The bald eagle is known to winter within the Great Divide Basin. Two observations have been recorded on the WOS for the GWA II analysis area--one during the winter of 1990-91 (Sec. 33, T19N R93W), and the other during the winter of 1993-94 which was an observation of an electrocuted bald eagle (Sec. 20, T19N R93W). Several winter sightings of bald eagles have been made within a few miles of the northeastern and southeastern boundaries of the GWA II

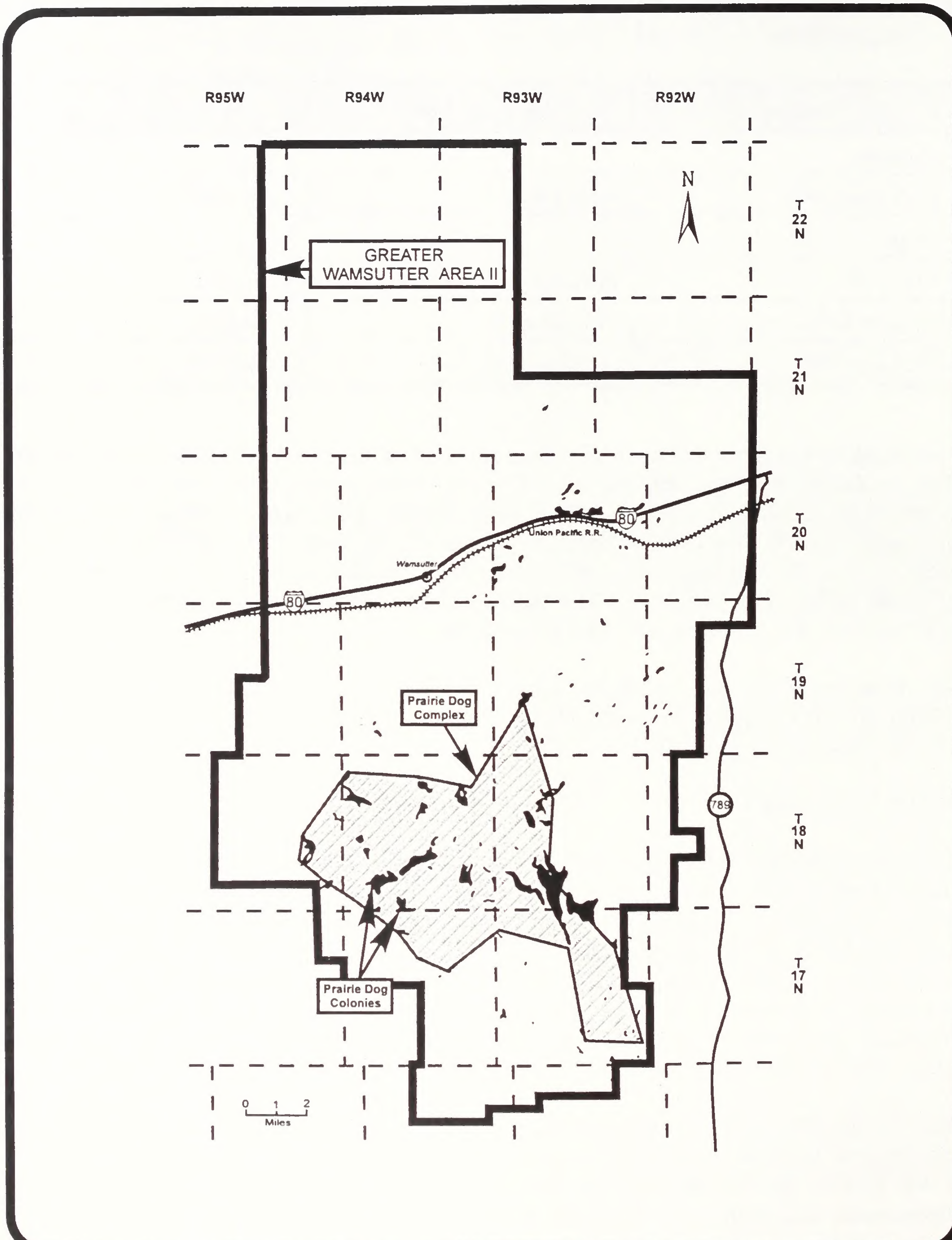

Exhibit 3-4. Prairie Dog Colonies in the GWA II Analysis Area.

analysis area. Due to the absence of open water, possible roosting trees, and a suitable prey base, bald eagles are unlikely to occur on GWA II analysis area, except during their occasional hunting excursions in winter.

3.7.3.3 Peregrine Falcon

Nesting habitat of the peregrine falcon usually is on a cliff face 200 to 300 feet high, although cliffs as high as 2,100 feet have been used. Most known nest sites are below 9,500 feet elevation but nests located as high as 10,500 feet elevation have been documented (USDI-FWS 1984). An available prey base of shorebirds, waterfowl, and/or small- to medium-sized terrestrial birds usually occurs within 10 miles of the nest site. Wetlands and riparian zones, as well as open meadows, parklands, croplands, lakes and gorges are potential habitats in which prey bird species are found and easily hunted by peregrines. Nesting peregrines may, however, hunt up to 17 miles from their aerie to locate prey (USDI-FWS 1984).

Bird populations on the GWA II analysis area appear to be abundant and diverse enough to support peregrines and some of the cliffs along the Delaney Rim on the western edge of the GWA II analysis area are high enough to provide suitable nesting habitat. In spite of the presence of what appears to be suitable habitat, no peregrines were observed by HWA biologists within the GWA II analysis area during the 1992 and 1994 field surveys, and there have been no recorded sightings in either the WOS or the WYNDD. Peregrine falcons may migrate through several portions of the GWA II analysis area but no nesting by this species has been documented near any area of the project.

3.7.3.4 Whooping Crane

Whooping crane breeding and wintering habitats have been described for the sub-population that nests within the Wood Buffalo National Park and winters on the Arkansas NWR along the Gulf of Mexico in Texas (Whooping Crane Recovery Team 1986). Most cranes in the sub-population introduced at Grays Lake NWR spend summers throughout eastern Idaho and western Wyoming and spend winters in the vicinity of Bosque Del Apache NWR in west-central New Mexico (Whooping Crane Recovery Team 1986). Habitats used include marshes and swamps, wet meadows, and grain fields near water (Dorn 1981). Similar wetlands habitats are used by migratory whooping cranes along the North Platte River in Nebraska (Aronson and Ellis 1979).

Each pair of whooping cranes requires about 1,000 acres of undisturbed marsh for nesting and about 400-600 acres for winter feeding (Mackenzie 1977). Wetlands are extremely limited within the GWA II analysis area and the possibility of a whooping crane using the area is remote. No whooping cranes were observed by HWA biologists within the GWA II analysis area during the 1992 and 1994 field surveys, and there have been no recorded sightings in either the WOS or the WYNDD.

3.7.4 Candidate Wildlife Species

Wildlife species which are not listed as endangered or threatened but have been listed by the FWS for possible listing in the future are classified as candidate species. Several categories exist for classification, based on the amount of information available and population numbers for the species. Candidate species are defined in the WYNDD (1992) as:

Category 1. Species that are in the process of being proposed as endangered or threatened and such a listing would be expected in the near future.

Category 2. Species for which there is some evidence of vulnerability but for which there are insufficient data to support listing and for which additional study is needed.

Category 3C. Species that have proven to be more abundant or widespread than was previously believed and/or those that are not subject to any identifiable threat. Should further research or changes in land use indicate significant decline in any of these species, they may be reevaluated for possible inclusion in Category 1 or 2.

The FWS has determined that seven wildlife species, listed as candidate species by the ESA, are potentially present in the project area (USDI-FWS 1994; Appendix A). The seven candidate species, and their federal status under the ESA, that may occur on or adjacent to the project area include the species listed in Table 3-18.

Table 3-18. Candidate Wildlife Species Potentially Present in the GWA II Analysis Area.

Species	Scientific Name	Status
Birds		
White-faced ibis	*Plegadis chihi*	2
Ferruginous hawk	*Buteo regalis*	2
Columbian sharp-tailed grouse	*Tympanuchus phasianellus*	2
Mountain plover	*Charadrius montanus*	1
Long-billed curlew	*Numenius americanus*	3C
Black tern	*Chlidonias niger*	2
Loggerhead shrike	*Lanius ludovicianus*	2

These species are addressed in more detail in the document entitled *Biological Assessment of Threatened, Endangered, and Candidate Species for the Greater Wamsutter Area II* prepared by Hayden-Wing Associates (1994b), which is incorporated into this EIS by reference.

3.7.4.1 White-Faced Ibis

The white-faced ibis feeds in wet meadows and shallow water found along streams and lakes. They nest in areas with extensive water, which is required for successful reproduction, building their nests in heavy emergent vegetation such as cattail and reed (Dinsmore 1983). Extensive water and emergent vegetation is almost non-existent in the GWA II analysis area and ibis use beyond casual migratory resting and feeding is unlikely.

The WOS (WGFD 1992a, 1994) records one white-faced ibis observation (1981) on the GWA II analysis area and two observations within a few miles of the GWA II analysis area boundary. During April, 1992 field surveys, one ibis was observed at the marshy area of Echo Springs by HWA personnel. During early May (5-7), 1994 wetlands and adjacent areas in the northern and southern portions of the GWA II analysis area were ground-surveyed. White-faced ibises were found at two locations in south GWA II analysis area; one ibis was seen at Coal Bank Lake and two ibises were seen on North Red Lake. It appeared that the two seen on Red Lake were pair-bonding and, although unlikely, may be nesting. Waterfowl and shorebird nesting habitat is limited within the GWA II analysis area because of the ephemeral nature of the water supply, and it is likely that most aquatic birds use the area only for resting and feeding during migration.

3.7.4.2 Ferruginous Hawk

Throughout their range, ferruginous hawks have been documented nesting on a wide variety of substrates (Evans 1983). In Utah for example, ferruginous hawks nested on junipers, pinyon pines, cottonwoods, on the ground, low hills and knolls, low cliffs, and on artificial structures (Smith and Murphy 1973). Generally, this species nests where visibility is extensive and this, in part, may contribute to the species' relatively high sensitivity to human disturbance (Suter and Joness 1981, Taylor 1988). In the GWA II analysis area, the ferruginous hawk stick nests are typically located on rock outcrops which are elevated from the surrounding terrain. These hawks lay eggs from mid-March through early April and the young fledge from early June to early July (Call 1978).

Ferruginous hawk sightings and evidence of nesting activity are common in the GWA II analysis area and a total of 80 ferruginous hawk observations documented in the WGFD's WOS records for the period extending from 1978 through 1993. During 1994, the BLM surveyed prime raptor nesting habitats and known raptor nesting concentration areas on GWA II analysis area. As a result of this survey and HWA's (1992) records, 51 ferruginous hawk nests have been located in the GWA II analysis area and within 1/2 mile of the boundary of the area. Eight active ferruginous hawk nests were found during the 1994 BLM survey. Three of these were on natural substrates, one on an abandoned condensate tank, and four on artificial nesting structures.

3.7.4.3 Columbian Sharp-Tailed Grouse

Columbian sharp-tailed grouse require good quality grasslands with relatively tall to tall dense stands of grass. Nesting habitat is usually the limiting factor for sharp-tailed grouse populations. Good nesting habitat contains tall dense grass on which little or no grazing occurs and that has some cropland present (Hillman and Jackson 1973). The grasslands within the GWA II analysis area meet none of these habitat requirements and the occurrence of sharp-tailed grouse in this area is unlikely.

No Columbian sharp-tailed grouse were observed on the GWA II analysis area by HWA biologists during 1994 field surveys of candidate species and there have been no recorded sightings in either the WOS or the WYNDD.

3.7.3.4 Mountain Plover

The mountain plover is known to nest in Wyoming (Dinsmore 1983) and prefers open, level or slightly rolling areas dominated by blue grama and buffalograss. Such areas are also characteristic of white-tailed prairie dog habitat, which is why the mountain plover is often seen within or near prairie dog colonies. Large amounts of nesting and foraging habitat are available within the GWA II analysis area and the potential for a relatively large population of plovers appears to exist.

Four sightings of mountain plover within the GWA II analysis area are documented in the WOS, two in 1981 and two in 1994. Two were also reported approximately 15 miles south of Wamsutter during a 1990 breeding bird survey (Jahnke 1992). Mountain plover were observed by HWA biologists, during 1994 field surveys of candidate species, at two locations in south GWA II in early May. Two pairs (probably breeding pairs) were found within two prairie dog colonies. Although few mountain plover have been recorded in the area, there are many acres of apparently suitable habitat and it is likely that there could be relatively large numbers of them within the southern portion of the GWA II analysis area.

3.7.3.5 Long-Billed Curlew

Long-billed curlews prefer nesting in areas of natural shortgrass prairie. Curlews build their nests in shallow scrapes on the ground, often several kilometers from water, usually within close proximity to open lakes and sloughs (Dinsmore 1983). Some marginal habitat for curlew nesting and migration is available within the GWA II analysis area; however, the limited amount of permanent wetlands, sparse grass and grazing by livestock are likely to make curlew nesting uncommon.

No long-billed curlews were observed by HWA biologists within the GWA II analysis area during 1992 and 1994 field surveys of candidate species and there have also been no recorded sightings in either the WOS or the WYNDD.

3.7.3.6 Black Tern

The black tern requires small to large marshes with extensive stands of emergent vegetation for nesting, and often builds nests on muskrat houses (Johnsgard 1986). There is no suitable nesting habitat within the GWA II analysis area and black tern use of this area, beyond an uncommon migrant visitor, is unlikely.

There are two recorded black tern sightings in the WOS (WGFD 1992a)--one in central GWA II (1980) and the other within a few miles of the eastern boundary (1981). No reported sightings are listed in the WYNDD and none were observed by HWA biologists within the GWA II analysis area during 1994 surveys for candidate species.

3.7.3.7 Loggerhead Shrike

Loggerhead shrikes prefer open country for nesting and feeding, within close proximity to brushy areas containing trees or shrubs taller than six feet (Dinsmore 1983). These types of areas are limited to a few of the larger drainage basins and draws in the GWA II analysis area, but these draws may contain a relatively dense breeding population.

Twenty-one shrikes were observed by HWA biologists during the 3-day survey of the GWA II analysis area. Fourteen of these shrikes (7 pairs) appeared to be breeding pairs and are likely to be nesting in or near the locale where they were found.

3.7.4 Big Game

Three big game species, pronghorn antelope (*Antilocapra americana*), mule deer (*Odocoileus hemionus*), and elk (*Cervus elaphus*) occur on the GWA II analysis area. Approximately 18,506 acres of crucial winter range for pronghorn occurs within the GWA II analysis area. The amount of crucial winter range available is generally considered to be the single most important factor limiting the carrying capacity of the range for big game species in northern climates.

<u>Pronghorn Antelope</u>. The GWA II analysis area is contained almost entirely within the Red Desert and Bitter Creek herd units, while only a small area of non-crucial winter/yearlong range (about 630 acres) on the eastern edge of the GWA II analysis area lies within the Baggs herd unit. The Red Desert herd unit is located north of I-80 and the Bitter Creek herd unit to the south of I-80 and west of Highway 789. The Baggs herd unit is located to the east of Highway 789. Collectively, these herd units are comprised of hunt areas 53, 54, 55, 57, 58, 60, 61, and 64.

Seasonal pronghorn ranges, as delineated by WGFD, are illustrated in Exhibit 3-5. Crucial winter range within the GWA II analysis area occurs along a 2-mile wide band which lies directly north of I-80, extending approximately three miles west of Wamsutter east to Creston Junction. This area includes 18,506 acres of habitat. All of this 18,506-acre band lies within the Red Desert

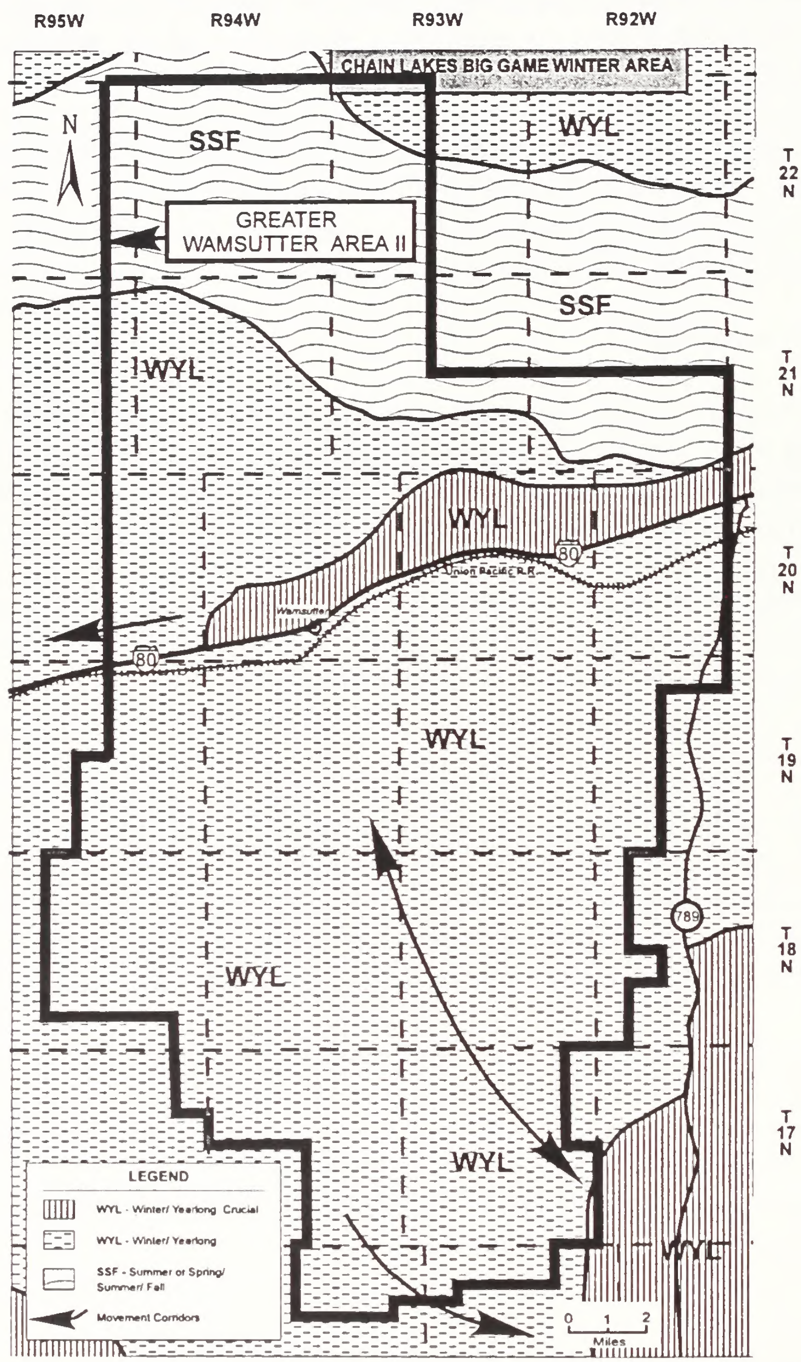

Exhibit 3-5. Seasonal Pronghorn Ranges within the GWA II Analysis Area.

Herd Unit. Additional designated antelope crucial winter range includes a narrow strip (206 acres) just inside the southeastern corner of the GWA II analysis area. All of this strip lies within the Bitter Creek Herd Unit. The remaining habitat within the GWA II analysis area is designated as either winter/yearlong range or spring/summer/fall range.

The 1993 post-season population estimate for the Red Desert herd unit is 13,300 animals and is 11 percent below the objective of 15,000. Fawn production improved in 1993, which allowed the herd to grow about 4 percent. The population objective was increased from 12,000 in 1992 to 15,000 in 1993 to allow for an increase in herd size (WGFD 1993b).

The Bitter Creek antelope unit is not a distinct population because animals interchange freely with other antelope in Colorado. The post-season population objective for antelope within this herd unit has undergone a significant increase from 11,000 animals in 1992 to 25,000 antelope in 1993 (WGFD 1993a). This would translate to an average of 8.57 antelope per square mile.

<u>Mule Deer</u>. The GWA II analysis area is contained within the Steamboat, Baggs, and Chain Lakes herd units involving hunt areas 82, 84, 85, 98, 100 and 131. Habitat designations are illustrated in Exhibit 3-6, and show that all mule deer habitat on the GWA II analysis area consists of winter/yearlong and yearlong ranges (216,175 acres). No crucial winter mule deer range occurs on the GWA II analysis area and much of the area (118,016 acres) is not classified as mule deer habitat at all ('out' range designations).

The Chain Lakes herd unit contains a relatively small population of mule deer (estimated at 380 for 1993), found in isolated pockets of suitable habitat. Minimal data are collected on this herd due to its small size and scattered distribution. As a result, the current population estimate of 380 for this herd is considered unreliable, but nevertheless, below the objective of 500 deer (WGFD 1993b). The post-season population objective for this herd unit was increased from 200 in 1992 to 500 in 1993. The analysis area north of I-80 and east of Wamsutter is included in this herd unit with yearlong and 'out' range designations.

The Baggs herd unit, located south of I-80 to the Colorado border, is very important to sportsmen due to the high hunter success rate there. In 1990, this herd unit had the fifth highest number of hunters and harvest in Wyoming (WGFD 1992b). The 1993 post-season population estimate of 13,076 is 30 percent below the objective of 18,700 mule deer. All the GWA II analysis area within this herd unit is designated winter/yearlong habitat, with migrations through the analysis area as mule deer move to winter/yearlong crucial ranges along Muddy Creek, southeast of the analysis area (WGFD 1993a).

The Steamboat herd unit, located north of I-80 and west of Wamsutter, consists of a herd of relatively low density that concentrates in areas of suitable habitat within a desert environment. The 1993 population estimate of 2,048 is almost half that of the 4,000 population objective (WGFD 1993a). Habitat surrounding seeps and springs along with aspen stands and riparian zones are very important to this population. The GWA II analysis area within this herd unit is designated as 'out' of mule deer range.

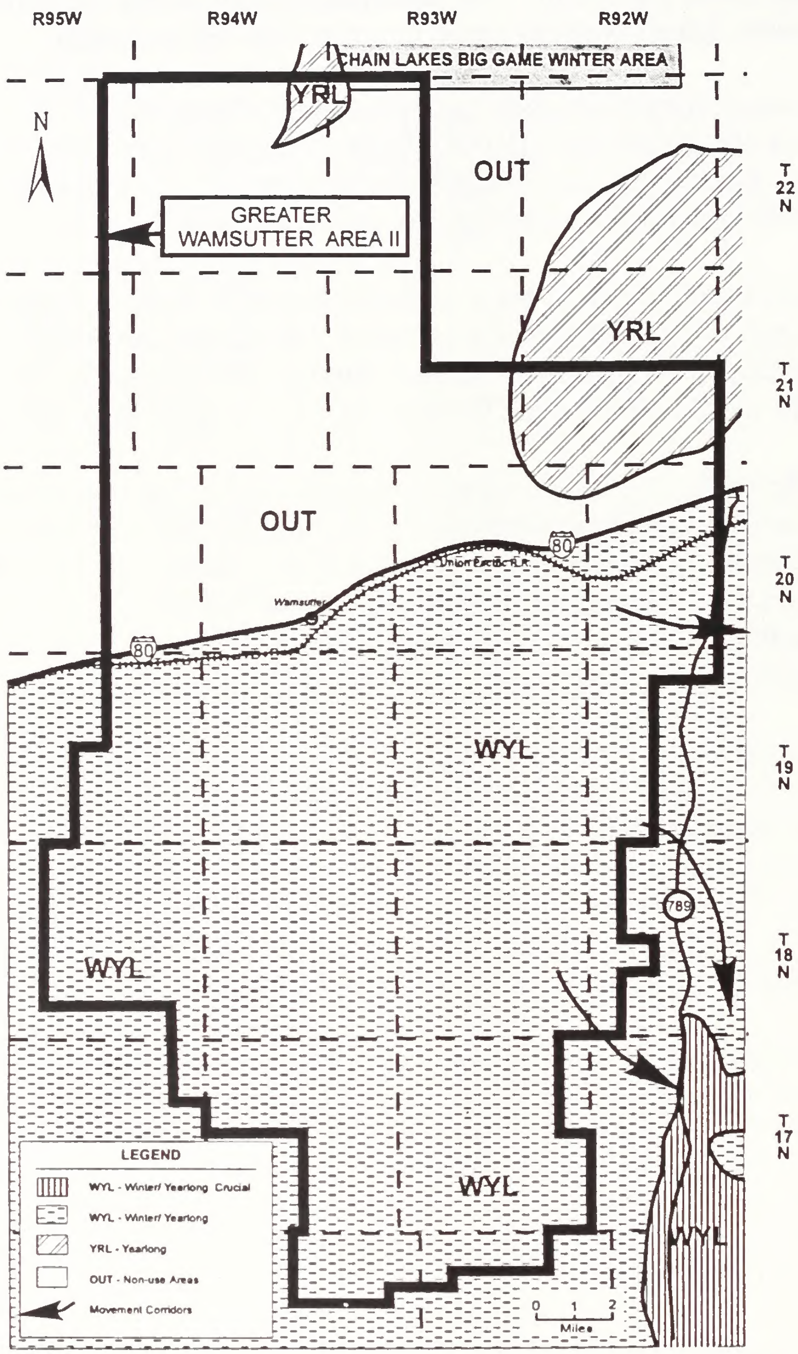

Exhibit 3-6. Mule Deer Habitat Designations.

Elk. Portions of both the Shamrock and Steamboat herd units are included within the GWA II analysis area and contain portions of hunt areas 100 and 118. Both herd units lie north of I-80, with Shamrock occurring east of Wamsutter and Steamboat occurring west of Wamsutter. Seasonal elk ranges are illustrated in Exhibit 3-7.

The Shamrock elk population, estimated in 1993 at 91 animals, was established in 1972 by elk wandering into the area; the area has a population objective of 75 (WGFD 1993b). Minimal data are collected on this herd due to its small size and the dispersal of the elk over a large area. Public interest in this herd is increasing, along with landowner concerns over range use and elk competition with livestock. A portion of the Shamrock herd unit, designated as yearlong elk range, lies within the GWA II analysis area (R92-93W:T20-21N).

The Steamboat elk herd is the only elk herd in the state which exists almost entirely on the sagebrush desert ecosystem. The 1993 population, estimated at 510, is popular with hunters as success rates are high and mature bulls make up a large percentage of the harvest (WGFD 1993a). No designated elk habitat of this herd unit occurs within the GWA II analysis area.

3.7.5 Sage Grouse

Sage grouse (*Centrocercus urophasianus*) are common inhabitants of the extensive sagebrush/grassland habitat of the region in which the project area is located. Historical sage grouse lek locations were obtained through the BLM office in Rawlins, Wyoming and from the WGFD in Sinclair, Wyoming.

The GWA II analysis area was flown by HWA biologists during two survey periods, one in April, 1992 (USDI-BLM 1992a) and the other in late March and early April, 1994 (HWA 1994a). During each period, aerial survey techniques, as described in the Handbook of Biological Techniques (WGFD 1982), were used to search for new leks and check existing known leks. One-half mile wide transects were flown in a north-south direction from a high-winged Cessna aircraft flown at about 200 feet above ground level. In addition to the 19 historical leks, two new leks were discovered by HWA personnel; one in 1992, located in Section 13;T19N R93W and the other in 1994 located in Section 2;T21N R93W.

Each new and historical lek was checked three times from either the ground or the air. Each of these observations were made within a two-hour period that began at first light in the morning. Numbers of male and female sage grouse in attendance were recorded during each visit. Legal descriptions of lek locations were either verified or determined and placed on 1:24,000 topographic maps. The 21 lek locations are illustrated in Exhibit 3-8. Grouse attendance, along with dates of observations, of the respective leks is documented in the GWA EA (USDI-BLM 1992a) and the wildlife technical report for the Greater Wamsutter Area II (HWA 1994a). Ten of the 21 leks had no birds present during any of the ground or aerial visits and may no longer be active or be temporarily inactive due to protracted drought conditions. The other 11 leks had from two to 20 males in attendance (USDI-BLM 1992a, HWA 1994a).

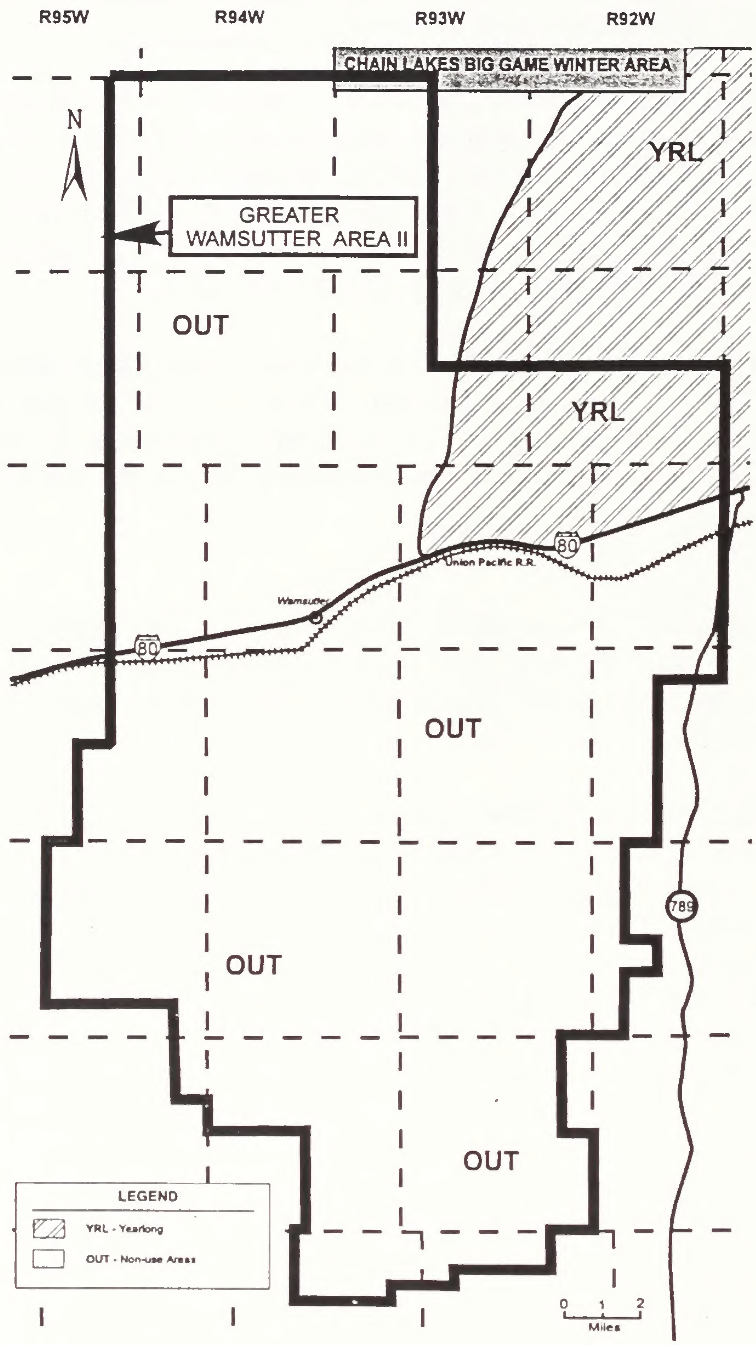

Exhibit 3-7. Seasonal Elk Ranges of Shamrock and Steamboat Herd Units.

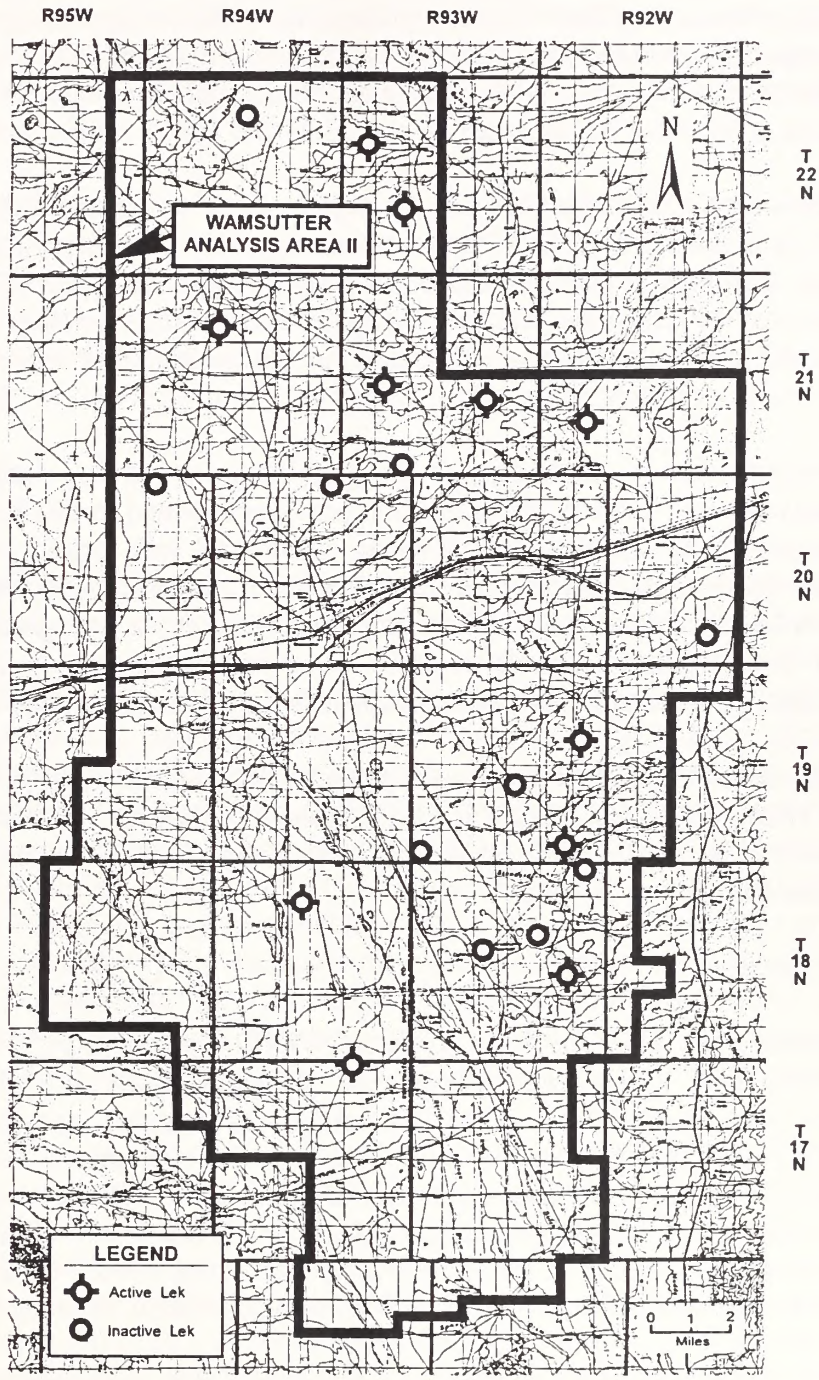

Exhibit 3-8. Sage Grouse Lek Locations.

3.7.6 Raptors

Records from the WGFD and BLM show that twelve raptor species have been observed on the analysis area since the mid 1970s. The ferruginous hawk (*Buteo regalis*), golden eagle (*Aquila chrysaetos*), burrowing owl (*Anthene cunicularia*), and prairie falcon (*Falco mexicanus*) are the most commonly reported raptors. Over 64 nest locations, including inactive nest sites/artificial nesting structures, have been documented by the BLM and HWA within the analysis area.

Aerial raptor nest surveys for the GWA II analysis area were conducted during the spring of 1992 by HWA personnel and by BLM personnel during 1994. The largest proportion of these (79 percent) are ferruginous hawk nests, while golden eagles (11 percent), red-tailed hawks (*Buteo jamaicensis*) (8 percent), and prairie falcons (2 percent) comprise the remainder. Historical burrowing owl nest sites are also documented in the BLM records for the area but activity status was not checked.

The greatest concentration of raptor nests is along Delaney Rim in the southwestern section of the GWA II analysis area. At least 25 nests have been documented in this area. Several golden eagles and ferruginous hawks have built nests on existing oil well tanks. Attempts have been made to relocate the nests using artificial nesting structures and have been particularly successful with ferruginous hawks. According to BLM officials, all available ferruginous hawk structures were occupied by ferruginous hawks in 1994. However, eagle nesting structures are only intermittently used. One ferruginous hawk occupied one eagle nesting structure.

Other raptor species reported on the GWA II analysis area include the bald eagle, Swainson's hawk (*Buteo swainsoni*), rough-legged hawk (*Buteo lagopus*), American kestrel (*Falco sparverius*), northern harrier (*Circus cyaneus*) short-eared owl (*Asio flammeus*), and great horned owl (*Bubo virginianus*).

3.7.7 Other Species

All wildlife species that have been recorded on the WGFD computerized WOS (WGFD 1992a, 1994), within the project area and a peripheral zone of approximately five miles are listed in the biological assessment report (HWA 1994). The total of 113 species includes 27 mammals, 84 bird species, one reptile, and one amphibian. Although all of the species listed in the technical report are important members of wildland ecosystems and communities, most are common and have wide distributions in the region. Consequently, the relationship of these species to the proposed project is not discussed in the same depth as species which are threatened, endangered, rare, of special economic interest, or are otherwise of high interest or unique value.

3.8 FISHERIES

No perennial streams occur on the GWA II analysis area which is drained primarily via the Washakie Basin which carries intermittent/ephemeral runoff events generated by spring snowmelt and summer thunderstorms southward into the Little Snake River. These drainages are dry much of the year, do not support fish life, and are classified as intermittent or ephemeral (Class 4) by the WDEQ.

As described in Section 4.5 (Water Resources), water used during drilling and construction would be nominal in volume (1,209 acre-feet) and would be obtained from State of Wyoming approved groundwater sources. The water pumped from these deep wells is drawn from aquifers that are isolated from Muddy Creek and the Little Snake River and which are not associated with any surface expression in these watersheds. Therefore, no water depletion that could affect Threatened, Endangered, or Candidate fish species would occur.

3.9 RECREATION

Recreation use of public and private lands within the GWA II analysis area primarily involves dispersed activities, as there are no developed public recreation sites or facilities in the project area. Although data on recreational visitation are not available, overall recreation use levels in the area are generally low, due both to the limited number of local area residents, mixed public and private land ownership, and road conditions that discourage vehicle access into many backcountry areas during periods of rain or snowfall. Other than fall hunting activity, the area attracts limited numbers of recreationists engaged in backcountry camping and hiking, wildlife and wild horse observation, off-road vehicle use, outdoor photography, picnicking, and scenic touring (USDI-BLM 1987a). Increased efforts by the Wyoming Game and Fish Department (WGFD) and BLM to implement a "watchable wildlife" program in the area may be attracting additional use by wildlife observers. Some recreation users are attracted to the area by the Chain Lakes Cooperative Management Area, located just outside the northeast corner of the GWA II project area. In addition, the historic Overland Trail runs east-west through the southern part of the project area, and intact segments of the trail attract some unknown numbers of visitors.

Backcountry recreation uses are concentrated during the fall hunting seasons. The area provides excellent pronghorn antelope hunting opportunities. Parts of the project area fall within antelope hunt areas 54, 57, 60, and 61. These units are managed by the WGFD as trophy hunting units, with a limited number of hunting permits available. For the 1994 hunting season a total of 300 buck antelope permits were available in areas 54/57 (combined), 150 buck and 50 doe/fawn permits in area 60, and 350 buck and 400 doe/fawn permits in area 61. For areas 54 and 57 the number of permits available in 1994 was reduced substantially from the number available in 1993 due to herd losses associated with several years of drought and high winter kill during 1992-93. Pronghorn antelope hunting begins in some hunting areas in the first week of September and continues in some areas through the end of the month.

Other fall hunting use occurs during the mule deer season in October (WGFD 1994), although the level of deer hunting activity in the GWA II project area is relatively low. The area also attracts upland and small game hunters, particularly during the September and October sage grouse season. Winter coyote hunting also attracts limited numbers of users to the area (Jahnke 1994).

3.10 VISUAL RESOURCES

3.10.1 Introduction

The following description of the affected environment is based on the BLM's land classification program for visual resources (Visual Resource Management [VRM]) (USDI-BLM 1986). Seldom-seen areas were delineated on USGS quad maps by identifying ridgelines or sharp breaks in contour as seen from major roads in the analysis area. The collective outlines described the viewsheds from all major roads and the railroad. Objects and activities within a viewshed would generally be visible. These initial delineations were field checked by traveling all major roads in both directions. Five on-site visits and interpretive work from topographic maps, photographs, and field notes compiled by other interdisciplinary (ID) team members were utilized to describe the affected environment.

3.10.2 Landscape Description

The analysis area is typical of the Wyoming Red Desert Region. The characteristic landscape is gently undulating with occasional badland breaks and stabilized dunes that stand out as contrasting forms. Small drainages dissect the landscape, adding visual diversity. The area north of I-80 is visually very homogeneous, relatively flat, and has very little diversity in vegetative cover types--primarily low sagebrush and patches of big sagebrush in drainages, depressions, and protected sites. This visual pattern is accentuated during the winter when grass-dominated areas are covered with snow, setting up a contrast of gray-green against white. Green and gray-green are the predominant colors during early spring. Large areas dominated by cheatgrass turn purple for a short period in late spring. The gray-green of sagebrush and the buff and ochre colors of curing grass dominate into the fall. The buff, gray, and reddish colors of the badlands and breaks provide a year-round contrast with the adjacent vegetation. Visual management direction for the area is shown in Exhibit 3-9.

There are very few dominant visual lines in the analysis area landscape. A diverse mosaic of vegetation and topography is most characteristic. The predominant vegetative cover is low sagebrush and grasses, with scattered stands of large sagebrush/rabbitbrush on northeast-facing slopes, along drainageways, and greasewood ringing many of the depressions. There are few, if any, trees. Evidence of cultural modification includes urban development, snow fencing, powerlines, fences, roads, railroads, and gas production facilities. As discussed in Section 2.7.2, an estimated 12,527 acres of landscape have been disturbed by previous activities in the analysis area, of which an estimated 8,883 acres are oil and gas field related (resource roads, local roads,

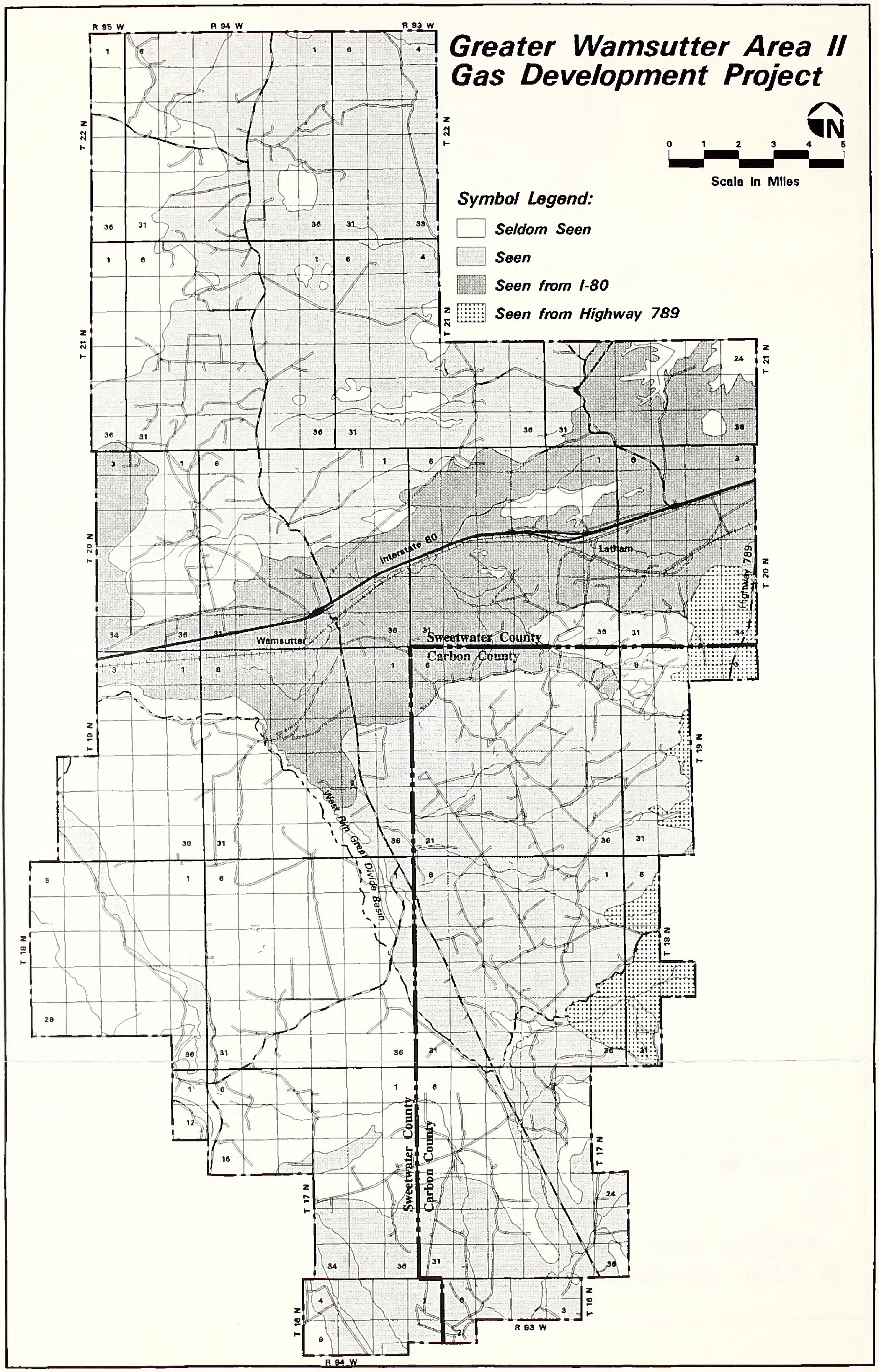

Exhibit 3-9. Viewsheds Seen from I-80 and Highway 789 within the GWA II Analysis Area.

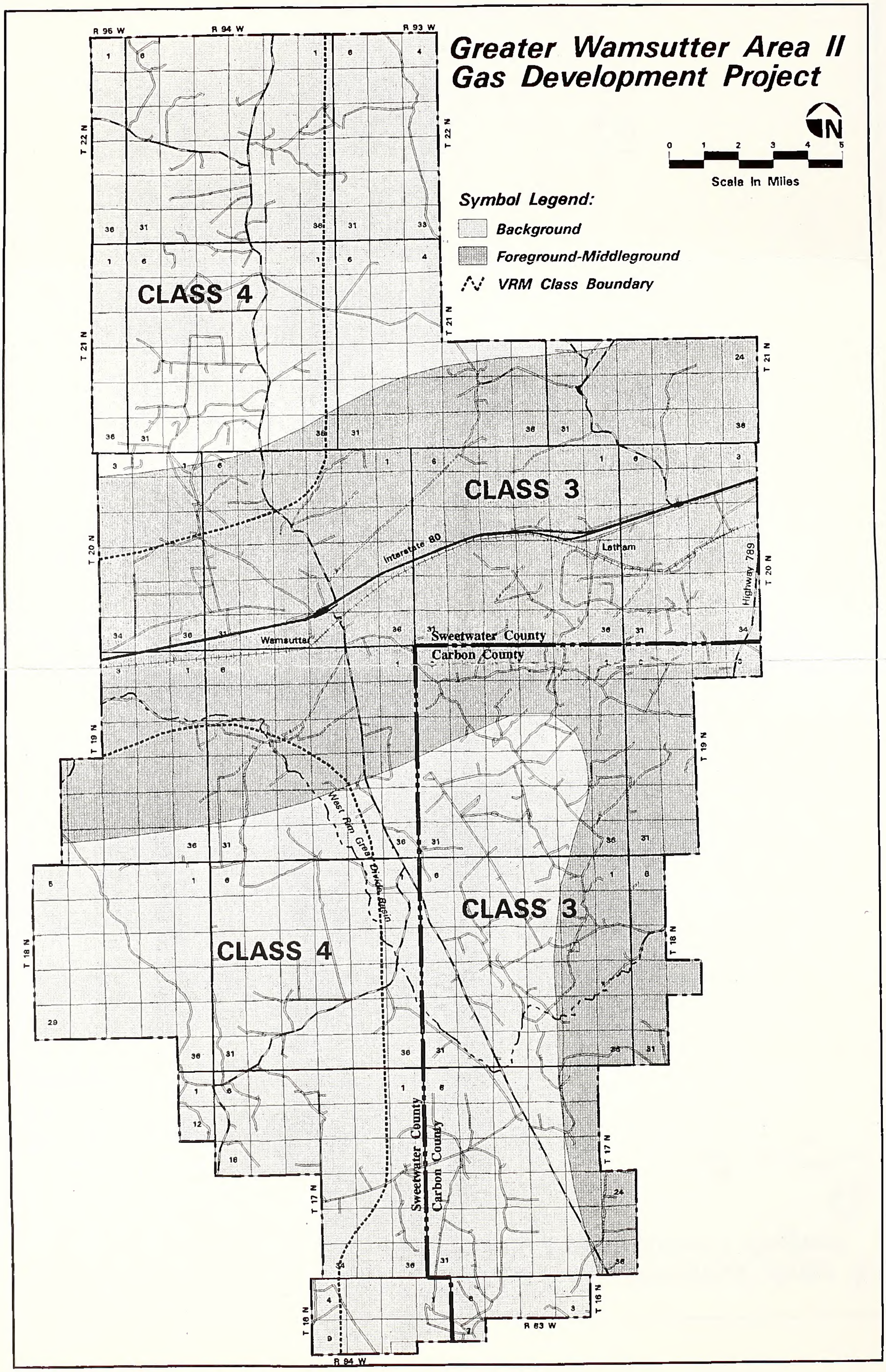

Exhibit 3-10. Visual Resource Management Direction in the GWA II Analysis Area.

collector roads, pipelines, drill/well sites, and production facilities). The balance of disturbance, 3,644 acres, is due to urban areas, railroads, and public roads as identified in Table 2-8. Many of these disturbance features are noticeable as contrasts in line and form when seen in relation to the adjacent undisturbed landscape.

3.10.3 Visuals Analysis

Motorists traveling I-80 and Wyoming Highway 789 would have visual access to an estimated 85 square miles and 19 square miles, respectively. Amtrak train passengers would be able to see into approximately 75 square miles of the analysis area. For some of these travelers, particularly tourists, the quality of the visual resource is an important component of the traveling experience. Of the 104 square miles visible from I-80 and Wyoming Highway 789, an estimated 38 square miles are in the immediate foreground of the viewshed (within one mile of the viewer). In total, 92 square miles are within the BLM's VRM foreground/middleground viewing distance zone (less than 3-5 miles away). The remaining 12 square miles are seen as background or are seldom seen. Many of the longer views are visible for one minute or less because of intervening topography relative to road elevation. An estimated 60 to 70 percent of the entire area would be visible from the Wamsutter-Dad road and the Wamsutter-Crooks Gap road. These roads are used primarily by oil field workers and recreationists, primarily hunters in the fall. Exhibit 3-9 shows these areas along I-80 and Highway 789.

Although there are no developed recreation sites, the area receives considerable use by recreationists, including big game and upland game hunters, feral or "wild" horse and wildlife watchers, as well as backpackers. The quality of the visual resource is typically an aspect of concern for these groups of users. Other users, including those working in the oil and gas industry and grazing permit holders, would also be affected by changes to the visual resource.

The intent of the BLM's VRM program is to preserve scenic values in concert with resource development. Visual resource specialists with the BLM have classified the visual resources in the analysis area as Class 3 (55 percent) and Class 4 (45 percent) as shown in Exhibit 3-10. The VRM program (USDI-BLM 1986) describes the levels of change to the visual resource permitted in Class 3 and Class 4 landscapes:

Class 3. The objective of this class is to partially retain the existing character of the landscape. The level of change to the characteristic landscape would be moderate. Management activities may attract attention but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.

Class 4. The objective of this class is to provide for management activities which require major modification of the existing character of the landscape. The level of change to the characteristic landscape can be high. These management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the impact of the activities through careful location, minimal disturbance, and by repeating the basic elements.Thus, for a Class 3 area, changes to the landscape should repeat the basic elements (form, line, color, and texture) and may draw attention of the casual observer but should not dominate their view. Class 4 area projects may dominate the view and be the major focus of the viewer's attention, but impacts associated with construction should be minimized.

3.11 CULTURAL RESOURCES

3.11.1 Introduction

The GWA II analysis area contains wide and varied cultural resources. This geographic region has been utilized by people from Paleoindian times until the present. Prehistoric hunters and gatherers occupied the region for more than 10,000 years. Historic trails brought Euro-American immigrants west and subsequently homesteads and mining sites became common in the area. Early 20th century to present day oil and gas development is present within the study area.

The overall density of cultural resources within the GWA II analysis area varies greatly. The highest densities of sites occur around springs such as Echo Springs and playas such as Eightmile Lake.

Archaeological test excavations and open trench inspections have demonstrated the occurrence of numerous buried archaeological sites. Most of these buried sites were discovered during open trench inspections, indicating the utility of this method as a tool for identifying sites lacking surface components. These buried sites are primarily associated with eolian deposits but have also been found associated with alluvial fill and colluvial deposits along the slopes of Delaney Rim. Typically, the sites have been well preserved. Since only a small portion of the sites have been the subject of test excavations, further testing of these sites would be likely to document additional buried materials. The sheer number of sites in the GWA II analysis area along with the common occurrence of intact buried remains indicate that the area has a high degree of archaeological potential or sensitivity.

The information on the cultural resources in the GWA II analysis area consists of material of a general and resource-specific nature. The general information includes overviews dealing with prehistoric and historic sites. These studies cover a larger area than GWA II and deal with the resources on a synthesis basis. One of the more important of these studies is an overview of the Overland Planning Unit (USDI-BLM 1984). The study consisted of a Class II cultural resource inventory and synthesis of the existing data base for the Planning Unit. The Planning Unit has since been restructured and today includes the Great Divide Resource Area. The study provides a summary of the prehistoric and historic culture histories of the study area.

An overview of historic resources of the Red Desert region was prepared by Rosenberg and Kvietok (1981). Although the study focuses on a small area of the Red Desert, it does outline a number of the important historic themes of the region. A synthesis of the prehistory of the southern portion of the Wyoming Basin has been developed by Metcalf (1987). The document establishes a refined prehistoric cultural chronology of the region, one that applies to the GWA II analysis area. No overview has been developed that deals specifically with the cultural resources in the GWA II analysis area.

Site-specific information consists of individual site reports in the form of site forms, survey and testing reports, and excavation reports. In order to characterize the cultural resources in the GWA II analysis area, site-specific information was gathered. The data were derived by conducting a file search through the State Historic Preservation Office (SHPO), Cultural Records Office, and checking the records of the BLM, Rawlins District, Great Divide Resource Area. Additional information was obtained from the records of Archaeological Services of Western Wyoming College in Rock Springs, Independent Archaeological Consultants of Rawlins, and from individual project reports.

The existing records contain information from hundreds of cultural resource studies in the GWA II analysis area. The vast majority of these studies are Class III inventories associated with oil and gas development. The inventories consist of both block and linear surveys. Block survey data consists of a wide range of ground coverage from small five acre parcels for a valve station to the inventory of entire sections. Block surveys have inventoried approximately 73,800 acres of both public and private land. Block inventory efforts have not uniformly covered the GWA II analysis area. The area of greatest block survey coverage is found within the Echo Springs and Standard Draw Units. In a number of cases, several sections or portions of sections have been surveyed more than once. Several thousand additional acres have been surveyed by linear projects, access roads, and pipelines in the GWA II analysis area but the total inventoried acreage cannot be calculated given the current level of synthesis. This existing information base is not of uniform quality. Surveys conducted prior to 1981 are currently not considered to meet the Secretary of the Interior standards for cultural resources. These pre-1981 studies are considered to be inadequate in terms of today's cultural resource requirements for development projects. Much of the larger block surveys (including the Wamsutter Amoco Block Survey) fall into this pre-1981 category. Even with the varying quality of the previous studies, the information base is sufficient to provide a good characterization of the types and number of cultural resources in the GWA II analysis area. This is especially true considering the large areas that have been block inventoried.

3.11.2 The Cultural Chronology of the GWA II Analysis Area

The prehistoric cultural chronology is based upon the sequence detailed by Metcalf (1987) for the southern Wyoming Basin, including the Great Divide and Washakie basins. The Metcalf model for the cultural chronology of the Wyoming Basin is a revision of the cultural chronology developed by Frison (1978) from the Northwest Plains. This revision was necessary because the cultural chronology of the Wyoming Basin is unique and had not been properly addressed by models from the surrounding culture areas. The characteristics of the chronology detailed by Metcalf (1987) are summarized in Table 3-19.

Table 3-19. Summary of the Prehistoric Cultural Chronology of the GWA II Analysis Area.

Period	Approximate Time Period
PaleoIndian Period	ca. 12,000 to 7,500 years B.P.
Archaic Period	ca. 8,000 to 1,500 years B.P.
Early	ca. 8,000 to 4,500 years B.P.
Great Divide Phase	ca. 7,200 to 5,800 years B.P.
Green River Phase	ca. 5,800 to 4,200 years B.P.
Late	ca. 3,000 to 1,500 years B.P.
Pine Spring Phase	ca. 4,200 to 3,000 years B.P.
Deadman Wash Phase	ca. 3,000 to 1,800 years B.P.
Transition	ca. 1,800 to 1,600 years B.P.
Late Prehistoric Period	ca. 1,800 to 250 years B.P.
Uinta Phase	ca. 1,800 to 1,000 years B.P.
Firehole	ca. 1,000 to 300 years B.P.
Protohistoric Period	ca. 450 to 150 years B.P.

The historic chronology of the area is summarized in the Overland Planning Unit Class II document. Rosenberg and Kvietok (1981) provide additional information. The beginning of the historic period began with the arrival of the first traders and trappers, circa 1825. The previous Class II study has identified six important themes or periods within the study area. These periods are summarized in Table 3-19.

3.11.3 Summary of the Cultural Resource Data

There are presently 1935 known sites in the study area. Of these, 1808 are prehistoric and 127 are historic sites. For this discussion the known cultural resources have been grouped under various descriptive types (Table 3-20). Grouping sites into the defined types was based on the data provided in the file search. Most of the site data is based on surface inventory only. The prehistoric site types known in the GWA II analysis area are summarized in Table 3-20.

3.11.3.1 Prehistoric Site Types

Lithic Scatter. The lithic scatter site type is defined by the presence of chipped stone debitage and/or chipped stone tools and the absence of surface features. Sites in this category (n=1039) lack features and exhibit no evidence of the former presence of features (i.e., fire-cracked rock or charcoal staining).

Table 3-20. Summary of the Historic Chronology of the GWA II Analysis Area.

Historic Event	Approximate Dates
Traders and Trappers	(1825 to 1847)
The Cherokee Trail	1830 to 1868
The Overland Trail	1830 to 1868
Military Operations on the Overland Trail	1862 to 1868
The Early Railroad Era	beginning in 1864
Euro-American Settlement of the Study Area	beginning in 1864

In terms of cultural behavior, these sites represent short-term activities, although the site may have been used more than once. The sites are mainly associated with the production of stone tools. Lithic scatters comprise the majority (57.5 percent) of all recorded prehistoric sites.

Open Camp. Sites in the study area that are considered open camps contain evidence of a broader range of activities including subsistence-related functions. Formal features (primarily hearths or roasting pits) are present or their former presence is inferred. The sites may also contain lithic debitage, chipped stone tools, ground stone tools, and pottery. The sites served as residential locations associated with the collection, processing, and consumption of food resources. Open camps comprise 39.2 percent (n=710) of the prehistoric sites recorded in the GWA II analysis area.

Features Only. Sites that are grouped into this category consist solely of one or several formal features, such as hearths or tipi rings. No portable cultural material is evident. These sites comprise approximately 1.4 percent (n=26) of the total prehistoric sites in the GWA II analysis area.

Quarry. Sites defined as quarries are locations where lithic raw materials were collected and initially tested and reduced. Within the study area this includes the utilization of both primary outcrops and secondary deposits of a wide range of toolstone varieties. A number of primary sources have been identified in the study area. Exposures of the Green River Formation along Delaney Rim contain ostracod and stromatolitic chert (Church et al. 1983; Love 1994 In prep.). This material has been redeposited to the west and occurs as cobbles on lag surfaces. Another source of toolstone is a porcellanite formed by a burned underground coal seam. This material occurs north of Interstate 80 at Latham Draw (Creasman et al. 1982). Thirty-three (1.8 percent) of the recorded prehistoric sites are quarries.

3.11.3.2 Historic Site Types

Following is a list of the types of historic sites found within the study area. The type names are those used by the SHPO Cultural Records Office as coded from site forms. There is some overlap among types and some ambiguity as to the assignment of sites to a specific type. The types are summarized below (see Table 3-21 for a numerical breakdown).

Stockherding. Sites given this distinction contain refuse left behind in a temporary, stock-tending situation. Ranching sites are, for the most part, found in areas that provide a vista or vantage point, are near a bedding area, and are located near a water source. Specifically, ridgetops or higher areas of relief that are relatively near a drainage or creek are likely to contain this type of site. This type site represents 39.4 percent of the historic sites recorded.

Transportation. Sites within the GWA II analysis area that are given this distinction are primarily railroad or railroad-affiliated facilities. The actual location of the railroad was dictated by topographic and engineering constraints. For example, the railroad grade closely paralleled the natural surface contour and made broad sweeping curves. The availability of bedding material for the railroad bed was also a factor. Therefore, in certain physiographic settings, such as a floodplain, the presence of a railroad is highly unlikely. Railroad-affiliated facilities (sidings, stations, and construction camps), were placed along the actual railroad bed and, therefore, their function and use is evident by association. The Lincoln Highway and U.S. Highway 30 were located within the analysis area. However, they are presently overlain by Interstate 80 and have not been recorded in the analysis area. This class represents 10.2 percent of the historic sites recorded.

Historic Debris. Sites in this category contain historic refuse that is not characteristic of the occupation. Additionally this generic category probably served as a catch-all for less experienced field recorders. Sites included in this type can not be associated with specific topographic features or settings. Forty-five historic sites (35.4 percent) are included in this category.

Overland Migration. Two historic trails are identified in the GWA II analysis area: the Overland Trail and the Wamsutter-Crooks Gap Road. Like the railroad, the trails follow the path of least topographic resistance. Two stage stations are located in the study area, both associated with the Overland Trail. Stage stations along the Overland Trail were spaced roughly equidistant from one to the next. Like the Trail itself, the stage stations were placed in areas of relatively flat topography, and preferably near a water source. Stage stations within the GWA II analysis area include Duck Lake and Coal Gulch.

Urban. Sites classified as urban are historic occupation sites consisting of Euro-American homesteads. These can occur at any location, taking into account the necessity for water. Historic homesteads represent 8.7 percent (n=11) of the sites recorded. The class includes the Hadsell Winter Headquarters and Eureka Headquarters.

Mining. A single historic mine (<one percent) has been recorded in the GWA II analysis area.

Table 3-21. Summary of Prehistoric and Historic Sites Located in the GWA II Analysis Area.

Site Type	Percentage of Sites per Type	Number of Sites per Type
Prehistoric Sites		
Lithic scatter	57.5	1039
Open camp	39.2	710
Quarry	1.8	33
Features only	1.4	26
Unassigned type	0.05	1
TOTAL	100.0	1808
Historic Sites		
Stockherding	39.4	50
Transportation	10.2	13
Historic Debris	39.4	45
Overland Migration	3.1	4
Unassigned	2.4	4
Urban	8.7	11
Mining	0.8	1
TOTAL	**100.0**	**127**

The site is a coal wagon mine. The locations of these types of sites are dictated by the presence of the desired resource. Mine-related facilities are usually located close to the actual mine. The availability of water was not an important factor in the locations of these sites.

Unassigned. This category contains the remaining historic sites not included in another category. The single known human burial is included in this category. This group represents 2.4 percent of the historic sites.

Site densities fluctuate considerably across the study area. This variability in site density is attributable to a number of factors. Prehistoric behavior patterns had a direct causal relationship on prehistoric site patterns. The inconsistent quality of archaeological survey and recordation have had an effect on the documentation of both prehistoric and historic sites. Given the status of the database and the non-uniform nature of the inventory coverage, causal factors relating to site location cannot be explicitly defined. It is clear that there are large-scale variations in site densities in the GWA II analysis area and that site densities are relatively high in comparison to other portions of southwest Wyoming.

The greatest amount of block survey work has been conducted in the Echo Springs and Standard Draw fields. Based on current survey data, the Echo Springs and Standard Draw fields have the highest site density within the analysis area. For example, the entire 640 acres comprising Section 27, T18N, R93W, contained 52 total sites; representing a density of one site/12.31 acres. The average across the state is around one site/60 acres.

Contrasting with the high site density of the Echo Springs/Standard Draw area is the Wild Rose Field. The areas that have been subject to block survey in the Wild Rose Field suggest a site density ranging between one site/90 acres to one site/320 acres.

The high site density areas within the Echo Springs and Standard Draw fields are associated with topographic and hydrologic features. These features are springs (Echo), playa lakes (Eightmile, Coal Bank, and Fivemile), and larger watercourses (Coal Bank Wash and Standard Draw). Areas away from these topographic and/or hydrologic features (such as the Wild Rose Field) tend to have much lower site densities. Given the arid nature of the environment, the attraction of water to prehistoric people is understandable. In addition to water for consumption, the human populations would be attracted to these areas because of the greater abundance of plant and animal resources.

3.11.4 Excavation Data

Few sites in the study area have been the subject of subsurface investigation. The majority of the work has been conducted as testing for the evaluation of NRHP status. Data recovery excavations have been conducted at fewer than five sites within the GWA II analysis area. These excavations have supplied some interesting information concerning cultural chronology, settlement types, and subsistence patterns, although the excavations have only begun to reveal the complex patterns of the region's prehistoric lifeways. A number of these excavation and testing projects are discussed below.

During 1982 an archaeological monitor was conducted of the MAPCO Wamsutter Extension Pipeline (O'Brien et al. 1983). The pipeline is situated primarily in the Echo Springs field. The monitor resulted in the discovery of buried prehistoric cultural resources, all within eolian deposits. Salvage excavations were conducted at three site locations: 48SW3691, 48CR1929, and 48CR3962. The sites appear to represent foraging camps occupied by small groups (several families). The duration of site use was probably relatively short, a few weeks at most. Season of use appears to have been during the late spring.

Site 48SW3691 is a multi-component open camp dating to the Early Archaic (Altithermal) and Late Prehistoric periods. Component 1 (5630 B.P.) is a small residential area associated with plant processing (roasting of *Chenopodium*). Component 2 (1570 B.P.) is also a small residential area which contained evidence of the use of *Opuntia, Polygonum*, and *Erigonum*. These plant resources were ground rather than roasted. The component also contained evidence of bone juice processing of bison and antelope elements. Both occupations are thought to represent late spring use.

Site 48SW1929 contained a single component, single activity area dating to 3600 B.P. The site is a small residential location. The investigators extrapolated that the site may have been associated with the collection and use of *Mentzelia* as a medicinal plant. *Mentzelia* was used as a remedy for burns. The presence of *Cleome* was also interpreted as evidence for use for medicinal purposes. *Cleome* was used for the treatment of sore eyes. However recent investigators suggest that *Cleome* seeds were an important food source. Occupation is thought to have occurred during the spring.

Site 48CR3962 is a multi-component site occupied in the post-Altithermal period. The carbon dates for this site range from 3850 to 4290 B.P. Component 1 appeared to have contained a habitation structure. Subsistence remains included a variety of plants. Only jackrabbits were identified as a utilized faunal species. Component 2 contained an activity area consisting of several features. Subsistence remains include cactus and *Typha* (cattail), and large- and medium-sized animals. The site components were thought to represent a spring occupation.

Sender et al. (1982) report the results of testing and salvage excavations at a number of sites as part of the archaeological studies for the Amoco Wamsutter Liquid Condensate Collection System. The analysis area is situated in the eastern portion of the Wild Rose Field and the Standard Draw field. The archaeological work associated with the project included testing at three sites (48CR3472, 48CR3473, and 48CR1946) and two other sites within a larger site complex (48CR3495 and 48CR1777), monitoring selected portions of pipeline construction, and limited salvage excavations of selected finds. No large block excavations were conducted. The investigations documented a large number of buried prehistoric components. Component ages range from 6600 B.P. to 1100 B.P. With the exception of the PaleoIndian and Protohistoric periods, all other cultural periods were represented. The results document the use of the Red Desert region during the Altithermal climatic episode. Both large mammal (i.e., bison-sized) and plant procurement occurred in the study area during the Altithermal climatic episode.

Site 48CR3472 was found to be a multi-component occupation. The site produced radiocarbon ages between 1370-1100 B.P., placing it in the Late Plains Archaic or Late Prehistoric periods. A comparison of animal processing tools versus those used for plant processing led to the conclusion that the predominant activity taking place at the site was plant processing.

Test excavations at 48CR3473 also encountered multiple components. The site produced radiocarbon ages associated with the Late Archaic period (4110 B.P.) and the Late Archaic-Late Prehistoric transition (1660 B.P.). This site exhibits repeated use as a temporary residential camp. The dominant activity associated with this site was lithic procurement and stone tool manufacture. Plant and animal processing was also taking place, but on a much smaller scale as compared to the sites investigated on the MAPCO pipeline.

Site 48CR1946 was tested and found to contain a series of components dating to the Early Archaic (6270-5130 B.P.). An additional component was dated to the Late Prehistoric (1020 B.P.). Small game animals, such as rabbits and rodents comprise the faunal assemblage. The presence of saltbush, biscuitroot, and goosefoot seeds indicate plant processing occurred during the occupation. The presence of the seeds suggest a mid- to late-summer habitation.

Excavations at Site 48CR3495 documented several Late Prehistoric period components (1650-750 B.P.). The excavations recovered charred seeds, including *Chenopodium*, saltbush, cactus, mustard, and Indian ricegrass. These materials point to plant procurement as the primary activity on the site. Evidence of some limited faunal processing was also recovered. Again a mid- to late summer occupation is indicated.

Site 48CR1777 was the subject of salvage excavations which document components dating from the Middle Archaic (3210 +/- 490 B.P.) to the Late Prehistoric periods. The presence of both ground stone and hunting tools suggests that subsistence activities included both plant and animal processing.

Creasman et al. (1983) provides yet another source of information concerning large scale excavation sites in the vicinity of the study area. The study included a single site in the GWA II analysis area on the north side of Latham Draw. (See Creasman et al. (1982) for related survey and test excavations.) Sites 48CR2200, 48SW4491, 48SW4492, 48SW1900, 48SW5016, 48SW5019, and 48SW5025 underwent large-scale salvage operations. These sites contain information concerning subsistence strategies ranging in dates from the PaleoIndian era to the Late Prehistoric. Sites within the general area include 48CR2200, 48SW4491, 48SW4492, 48SW1900, and 48SW5016. Site 48CR2200 is a multi-component site dating to the Early (4800 B.P.) and Late Archaic (1650 B.P.) periods. The primary site activity was plant and animal processing.

Site 48SW4491 is a multi-component site dating to the Early Archaic (5520 B.P.) and Late Archaic periods. Site activities were primarily plant and faunal processing.

Site 48SW4492 is a multi-component site. The occupations date to the PaleoIndian period (8020 B.P.), the Early Archaic, and the Late Archaic periods. The two early periods exhibit primarily plant procurement activities with limited faunal remains, whereas the Late Archaic component contained a projectile point and a hafted uniface suggesting hunting activities. The PaleoIndian period occupation contained evidence of a habitation structure.

Site 48SW1900 is a multi-component site containing Early Archaic (5510 B.P.) and Late Prehistoric (680 B.P.) components. The site was generally used as a small short-term camp where animal and plant processing took place.

Site 48SW5016 contains two Late Prehistoric components. The components radiocarbon date to 1510 B.P. and 700 B.P. The site activities are associated with small to medium-sized mammal processing and limited lithic reduction. Floral remains are marginal, but there was evidence of *Artemisia/Chrysothamnus* charcoal.

Most of the sites identified in the study area were recorded prior to 1985. Energy development in the past several years has resulted in increased numbers of archaeological investigations in the GWA II analysis area. These recent investigations, performed by the BLM and assorted consultants, have also illustrated the inconsistent and undependable nature of the pre-1981 work. Numerous sites were documented during the Amoco Wamsutter Block survey in 1980-1981. Attempts to relocate many of these sites have proved futile. It cannot be ascertained whether the difficulties in relocating previously recorded sites are attributable to poor quality archaeological work or to natural processes actually burying the sites.

Evidence from the limited amount of excavations in the study area indicate that prehistoric groups practiced a hunter-gatherer subsistence strategy. The sites and site components appear to represent short-term residential camps and extraction locales for specific resources (Binford 1981; Creasman and Thompson 1988, in press). These sites were used for a short period of time. From the base camps, work or task groups would forage for food, then return each evening. The site would be abandoned as nearby resources were depleted. The use of this basin area was mostly confined to the warmer months (spring and summer), reflecting only a portion of a highly mobile seasonal round.

The high site densities within the GWA II analysis area is reflective of the mobile settlement-subsistence strategy and the repeated reuse of the area on a seasonal basis for at least 9000 years. An important result of the excavation work that has been conducted is the documentation of buried cultural components with excellent preservation. These buried archaeological sites are commonly associated with eolian deposits but also have been found in colluvial and alluvial situations. A number of these discoveries had no surface evidence associated with the location.

3.12 SOCIOECONOMICS

3.12.1 Demographic and Economic Conditions

The GWA II project area is situated in eastern Sweetwater County and western Carbon County, Wyoming. U.S. Census figures indicate 1990 population totals of 38,823 for Sweetwater County and 16,659 for Carbon County. Areas of population concentration within proximity to the analysis area in these two counties are generally located along I-80. The town of Wamsutter, located just south of I-80 in the center of the analysis area, had a 1990 population of 240 residents. The town of Baggs, located about 50 miles south of the area, had a 1990 population of 272. Rawlins, located on I-80 approximately 40 miles to the east, had a 1990 population of 9,380. Rock Springs, located on I-80 approximately 60 miles west of the area, had a 1990 population of 19,050 (U.S. Bureau of the Census 1991).

Both Sweetwater and Carbon counties experienced substantial economic and demographic instability during the 1970s and 1980s, largely as a result of fluctuating levels of mining and energy resource development activities. These counties experienced sharp population growth (Table 3-22) between 1970 and 1980, when boom growth conditions were widespread throughout the energy development areas of Wyoming and other western states. Both counties lost population during much of the 1980s, largely as a result of out-migration associated with declining employment opportunities in oil and gas as well as in other energy resource industries. Carbon County experienced a 23.9 percent decline in total population between 1980 and 1990, while Sweetwater County experienced a decline of 6.7 percent for the same period. Since 1990, Sweetwater County has experienced renewed growth, with total county population increasing an estimated 6.9 percent between 1990 and 1993. Population estimates for Carbon County indicate that population declines continued during the early 1990s, with the total county population dropping by an estimated 3.9 percent between 1990 and 1993 (Wyoming Department of Administration and Information 1993).

Table 3-22. Population Trends in Carbon and Sweetwater Counties, 1970 to 1993.[1]

County	1970	1980	1982	1984	1986	1988	1990	1993
Carbon County	13,354	21,896	22,376	20,393	18,638	17,438	16,659	16,010
Rawlins	7,855	11,547					9,380	
Baggs	146	433					272	
Sweetwater County	18,391	41,723	45,752	42,477	44,222			38,823
Rock Springs	11,657	19,458					19,050	
Wamsutter	139	681					240	

[1] Source: Wyoming Department of Administration and Information, 1993.

Local officials from both counties indicate that they have observed a new surge of population growth during the past six to twelve months. In Sweetwater County the increased growth has reportedly been substantial, although data are not available to precisely quantify the level of growth that has occurred. The increased growth occurring in Sweetwater County is apparently linked to increased energy resource developments as well as new construction associated with increased levels of soda ash (trona) mining activity in the area surrounding Rock Springs and Green River (Kott 1994; Planning Information Corporation 1994). The town of Wamsutter has experienced substantial population growth due to renewed energy resource development in the area. In late June, 1994 the town population was approximately 450 persons, about 88 percent higher than the number reported in the 1990 population census (Carnes 1994). In Carbon County there is also evidence of somewhat more modest levels of recent population growth. Growth in the Rawlins area is attributed both to increased resource development activity in the surrounding area and to some "lifestyle-based" immigration of persons from outside the region such as is currently affecting many other areas of the Intermountain West (Gray 1994).

The fluctuating levels of population growth and economic activity evident in Sweetwater and Carbon counties are related in part to trends in the levels of oil and gas production (Table 3-23). In recent years Sweetwater County oil production has exhibited moderate fluctuations, while natural gas production increased significantly through the late 1980s and early 1990s. In Carbon County, oil production levels exhibited a sustained decline during this period, while natural gas production levels have remained relatively constant. In Sweetwater County and to a lesser extent in Carbon County, very substantial portions of local government and school district revenues are derived from the minerals industry, including oil and gas, in the form of property taxes and the distribution of a portion of mineral severance taxes and royalties to local units of government and school districts (Wyoming Department of Revenue 1994). For example, during fiscal year (FY) 1994, approximately 90 percent of Sweetwater County revenues and the revenues of the Rock Springs School Districts were derived from the minerals industry (Huekstaedt 1994). Despite fluctuating levels of exploration and production, the minerals industry has been the source of a majority of local revenues during the past twenty years. Consequently, periods of increased resource development such as has occurred during the past several years result in increased availability of funds to support public schools and services. Conversely, periods of declining resource development, such as occurred during most of the 1980s, result in revenue shortfalls and difficulties in maintaining established levels of public service provision.

Table 3-23. Oil and Gas Production Levels for Carbon and Sweetwater to 1992 (thousands of barrels and thousands of MCF).[1]

County	1988	1989	1990	1991	1992
Carbon County					
Oil (brls)	3,151	2,801	2,510	2,318	1,826
Gas (mcf)	51,696	55,220	50,819	51,330	52,000
Sweetwater County					
Oil (brls)					
Gas (mcf)	8,255	7,289	8,978	8,339	7,828
	145,549	161,265	174,443	200,757	211,823

[1] Source: Wyoming Department of Administration and Information, 1993.

Employment patterns in these counties reflect their differential levels of dependence on natural resource extractive industries. In Carbon County the number of persons employed in the mining sector dropped by over 80 percent between 1980 and 1988 (Wyoming Department of Administration and Information 1991). Employment in the mining sector has increased in recent years (Table 3-24), but as of 1991 was still only 8.9 percent of total employment in the county. The major employment sectors in Carbon County are public administration (22.8 percent of 1991 employment), services (19.1 percent), and retail trade (16.7 percent). Average unemployment in the county was 5.9 percent for 1992 and 1993, approximately 0.3 to 0.5 percent higher than the state average during this period. Revised unemployment calculation procedures adopted for 1994 are at least partially responsible for a higher unemployment rate figure of 7.0 percent reported for Carbon County in April, 1994; the corresponding statewide unemployment rate reported for this period was 6.7 percent (Kaminski 1994).

In contrast, the mining sector has remained the single largest source of employment in Sweetwater County for over a decade. Mining sector employment in Sweetwater County declined by over 35 percent between 1980 and 1987 (Wyoming Department of Administration and Information 1991), but increased each year from 1987 through 1991. As of 1991, mining sector employment comprised 23.2 percent of total county employment. Other major employment sectors in Sweetwater County are public administration (17.9 percent), services (16.7 percent), and retail trade (16.2 percent). County unemployment rates averaged 5.9 percent in 1992 and 6.2 percent in 1993, approximately 0.3 to 0.8 percent higher than the state average unemployment. The unemployment rate of 6.3 percent reported for April, 1994 was 0.4 percent lower than the statewide unemployment rate for that month (Kaminski 1994).

3.12.2 Housing and Service Infrastructure

Infrastructure development that accompanied the period of rapid growth of the 1970s and early 1980s created substantial excess capacity in both Sweetwater and Carbon counties during the mid- to late-1980s. However, recent increases in the levels of natural resource development and associated population growth pressures have created pressures on the housing supply and on some public and private services. As recently as 1990, housing availability was high in both counties. Data from the 1990 census indicate that there were 76 vacant housing units in the vicinity of Wamsutter and 1,173 vacant units in the Rock Springs area. An additional 997 vacant units were reported in the Rawlins area. In both counties, the vacancy rate for rental units was relatively high in 1990 (14.4 percent in Sweetwater and 21.4 percent in Carbon), indicating that the areas had substantial capacity to absorb substantial numbers of temporary residents associated with resource development activities (U.S. Bureau of the Census 1991). However, population growth during the past several years has substantially altered this situation. A recent housing inventory in Sweetwater County indicated that both houses for sale and rental units are in short supply in the Rock Springs area. Only 14 houses for sale and 48 rental vacancies were reported for Rock Springs as of June, 1993 (Planning Information Corporation 1994), and recent growth has undoubtedly caused additional pressure on the housing supply (Kott 1994). In the town of Wamsutter virtually all rental units are currently full as a result of growth associated with a

Table 3-24. Full and Part-Time Employment by Major Industry, Carbon and Sweetwater Counties, 1987 to 1991.[1]

County	1987	1988	1989	1990	1991
Carbon County					
Farm	586	564	550	547	4527
Agricultural Services	104	107	97	106	178
Mining	469	545	681	189	843
Construction	492	405	372	478	473
Manufacturing	538	524	662	624	623
Transportation and Public Utilities	749	777	823	326	811
Wholesale Trade	189	181	181	172	178
Retail Trade	1,667	1,738	1,741	1,613	1,574
Finance, Insurance and Real Estate	307	332	317	326	330
Services	1,811	1,763	1,721	1,777	1,804
Public Administration	2,150	2,156	2,186	2,145	2,152
TOTAL	**9,062**	**9,092**	**9,331**	**9,478**	**9,423**
Sweetwater County					
Farm	272	265	262	261	256
Agricultural Services	81	85	75	85	87
Mining	4,559	4,580	4,811	5,048	5,405
Construction	1,469	1,328	1,430	1,607	1,559
Manufacturing	517	538	561	775	729
Transportation and Public Utilities	2,143	2,116	2,202	2,205	2,173
Wholesale Trade	702	706	712	593	573
Retail Trade	3,270	3,428	3,349	3,621	3,774
Finance, Insurance and Real Estate	662	664	647	675	698
Services	3,684	3,539	3,548	3,734	3,884
Public Administration	3,884	3,840	3,908	4,011	4,171
TOTAL	**21,243**	**21,089**	**21,505**	**22,615**	**23,309**

[1] Source: Wyoming Department of Administration and Information, 1993.

recent increase in natural gas drilling in the area (Carnes 1994). In Rawlins the supply of both houses for sale and rental units is also currently limited; a survey of the city's five major apartment complexes conducted in late June, 1994 revealed only 15 vacant units (Gray 1994).

Additional temporary housing capacity is available in the form of numerous vacant mobile home pads, RV parks, and motel rooms in Wamsutter, Rawlins, and Rock Springs. For example, there were 238 vacant mobile home pads in Rock Springs as of June, 1993 (Planning Information Corporation 1994). In Wamsutter there are a number of empty mobile home spaces, including approximately 20 vacant spaces in a facility that was recently sold by its corporate owners and is scheduled to be reopened in the near future (Carnes 1994). Large numbers of mobile home spaces are also available in Rawlins (Gray 1994).

Public utilities such as water, sewer, electricity, and gas services were previously expanded to accommodate the growth of the 1970s and early 1980s. In Rawlins and to a lesser degree in Wamsutter these public utilities are capable of absorbing additional population growth (Carnes 1994; Adams 1994). However, there is substantially less capacity to absorb additional population growth in the Rock Springs area, where the city water supply system is currently operating at full capacity (Planning Information Corporation 1994).

Public school programs are provided through the Rock Springs School District #1 and the Rawlins School District #1. The Rock Springs School District currently operates an elementary school (K through 8) in Wamsutter; the school district has made arrangements to have students in grades 9-12 transported to Rawlins to attend high school. The Wamsutter elementary school has experienced modest enrollment declines in recent years, and the physical facilities could accommodate approximately double the enrollment levels (91 students) reported at the end of the 1993-94 school year. School capacity in the Rock Springs area facilities of School District #1 is also sufficient to accommodate some additional enrollment growth (Bernatis 1994). Rawlins area schools have experienced enrollment declines in recent years, and have ample room to accommodate enrollment increases (Gelsleichter 1994).

Medical care facilities in the area include Emergency Medical Technician/ambulance services located in Wamsutter, Rawlins and Rock Springs; hospitals in Rawlins (93 beds) and Rock Springs (99 beds); and private physician, dental, and other medical services in Rawlins and Rock Springs. At present there is a serious shortage of primary care physicians in the Rock Springs area. This has combined with recent population increases to cause considerable difficulties at the Sweetwater County Memorial Hospital, where the demand for emergency room services is currently at or in excess of capacity (Planning Information Corporation 1994; Roehrich 1994).

The Wyoming State Highway Patrol and the County Sheriff departments in both Sweetwater and Carbon counties provide law enforcement coverage for the area. Both Rawlins and Rock Springs also maintain their own police and fire departments. Recent increases in population in the Rock Springs and Green River areas have placed pressures on the Sweetwater County Sheriff's department and crowding in the county's jail and juvenile detention facilities (Planning Information Corporation 1994). Public safety services available in the town of Wamsutter include a town marshall and volunteer fire department, with additional local law enforcement coverage provided by one resident Sweetwater County sheriff's deputy and two Wyoming State Highway Patrol officers (Taylor 1994).

3.13 TRANSPORTATION

The regional transportation system serving Sweetwater and Carbon counties and the analysis area includes an established system of interstate, state, and county highways. The Union Pacific Railroad maintains a rail line through Sweetwater County in the analysis area, and the town of Rawlins. General aviation services are available at the Rawlins Municipal Airport.

Interstate 80. Interstate 80 (I-80) serves as an access route to the analysis area, and to county and state roads within or adjacent to the analysis area, including Wyoming Highway 789 heading south from I-80, and Sweetwater County Road 4-23 (Wamsutter-Dad Road). I-80 in the analysis area is built to interstate standards with four driving lanes and full shoulders.

Wyoming Highway 789. Wyoming Highway 789 is a two-lane, paved road that serves as a primary access route to BLM local and resource roads on the east side of the GWA II area.

Sweetwater County Road 4-23 (Wamsutter-Dad Road). Sweetwater County Road 4-23 is a two-lane graveled road providing access to the interior of the analysis area. The road traverses the area in a north-south direction, roughly bisecting the GWA II analysis area. The road provides access to numerous local and resources roads within the GWA II analysis area that service ongoing oil and gas production operations.

3.14 HEALTH AND SAFETY

Health and safety concerns for the affected environment include the risk associated with vehicular travel on paved, graveled, and unimproved roads as well as risks associated with low probability events such as floods, landslides, and earthquakes. The hazards associated with drilling and encountering hydrogen sulfide (H_2S) gas are discussed in Environmental Consequences (see Chapter 4).

3.15 NOISE

Other than vehicle traffic on I-80, Wyoming Highway 789, Sweetwater County Road 423, jet aircraft overflights at high altitudes, and localized vehicular traffic on two-track roads in the analysis area, only drilling and production operations related traffic going to and from the analysis area and ongoing drilling and production operations create even modest sound disturbances within, and in the immediate vicinity of the GWA II analysis area.

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CHAPTER 4

ENVIRONMENTAL CONSEQUENCES

CHAPTER 4

ANALYSIS OF ENVIRONMENTAL CONSEQUENCES

4.0 INTRODUCTION

This chapter of the EIS provides an analysis of the impacts or the potential environmental consequences that would result from implementation of the proposed Greater Wamsutter Area II natural gas production project and alternatives, including the project components (access roads, drill sites, well drilling, completion and production operations, and reclamation). Certain measures that would avoid or reduce impacts have been included in the Proposed Action as discussed in Chapter 2 and the Master Surface Use and Operating Plan, Appendix C. Additional information concerning reclamation is contained in the reclamation recommendations, Appendix B. The following impact assessment takes these measures into consideration. Additional mitigation beyond the measures proposed in Chapter 2 are summarized in Chapter 4, Mitigation Summary, for each resource discipline.

Since implementation of the No Action alternative would leave development within the GWA II as it currently exists with no impacts over and above those already occurring, this alternative is not discussed specifically under each resource element; however, consequences of the No Action alternative are summarized at the end of this chapter.

The description of the environmental consequences for each resource section in this chapter includes the following subsections:

Introduction - A description of the type and range of potential impacts that could occur as a result of implementation of the alternatives.

Impact Significance Criteria - The threshold or magnitude at which an impact would be considered significant, thus warranting special attention, such as special mitigation. These criteria are based on criteria from government regulatory standards, available scientific documentation, previously prepared environmental documents, and the professional judgement of resource specialists.

Direct and Indirect Impacts - An area-specific and site-specific impact assessment relative to the natural gas production alternatives. This section indicates which impacts are significant relative to the impact significance criteria.

Impacts Summary - A narrative comparison of direct and indirect impacts that would occur under each alternative and between alternatives.

Cumulative Impacts - A description of impacts likely to occur due to this project in combination with other ongoing activities, recently constructed projects, and projects likely to be implemented in the near future.

Mitigation Summary - A detailed summary of measures that could be applied to avoid or reduce impacts to levels not considered significant. Mitigation items specified in the mitigation summary are applicable to impacts on BLM-administered lands.

Residual Impacts - Significant impacts that are unavoidable and cannot be mitigated, and therefore would remain throughout the duration of the project and to some point beyond.

4.1 GEOLOGY/PALEONTOLOGY

4.1.1 Geology

With the exception of natural gas reserves, no major mineral resources would be impacted with implementation of the Proposed Action or alternatives to the Proposed Action within the GWA II analysis area. Mitigation measures discussed in Section 2.3.4.2.1 should reduce potential impacts to the geologic environment.

4.1.2 Paleontology

4.1.2.1 Introduction

Most of the GWA II analysis area is underlain at or near the surface by geologic deposits of Tertiary age with a high potential to contain nonrenewable fossil resources that are known to have scientific significance. Fossils which have been found in these deposits and that are known to have significant scientific interest and importance include the remains of plants, invertebrates, and vertebrates. Of particular importance are fossils of terrestrial and aquatic vertebrates of the early Tertiary age, including mammals, birds, reptiles, amphibians, and fish that are known world-wide and have been the source of much of the knowledge about the evolution of life during the Paleocene and Eocene epochs.

Construction of well pads, access roads, and production facilities and excavation of pipeline trenches could result in the exposure and possible destruction of fossil resources, along with the loss of associated geologic information. Construction-related disturbances could have beneficial impacts if new fossil resources are discovered and properly recovered and catalogued into the collection of a museum repository so that they are available for scientific study. The magnitude of adverse impacts can be reduced and beneficial impacts can be fostered by the implementation of paleontologic resource mitigation measures described in Section 4.1.2.6.

Fossils include body and trace remains of organisms that are older than recent in age. Although all fossils contain some information, not all fossils are of equal scientific importance. Scientifically significant fossils generally either: 1) provide important information about the evolutionary trends among organisms, or relate living inhabitants of the earth to extinct organisms; 2) provide important information regarding development of biological communities or interaction between botanical and zoological biotas; 3) demonstrate unusual or spectacular circumstances in the history of life; or 4) are in short supply and in danger of being depleted or destroyed by the elements, vandalism, or commercial exploitation, and are not found in other geographic locations.

4.1.2.2 Impact Significance Criteria

Adverse impacts to fossil resources occur when fossils of scientific significance are damaged or destroyed by construction. Significant impacts occur when scientifically significant nonrenewable fossil resources are damaged or destroyed as a result of construction activities.

Although all fossils contain some scientific information, few paleontologists of repute consider <u>all</u> fossils to have scientific significance. There is no precise definition of what constitutes a significant fossil or fossil resource, even among paleontologists. For that reason the following significance guidelines were established by members of the paleontologic community and recognized by the BLM to assist in this determination. These guidelines consider fossils to be of scientific value and thus of scientific significance if they:

- provide important information about the evolutionary trends among organisms, or relate living inhabitants of the earth to extinct organisms;

- provide important information regarding development of biological communities or interaction between botanical and zoological biotas;

- demonstrate unusual or spectacular circumstances in the history of life; or

- are in short supply and in danger of being depleted or destroyed by the elements, vandalism, or commercial exploitation, and are not found in other geographic locations.

There is also no accepted definition of how old remains must be before they are considered fossils, and thus of possible paleontologic significance. Generally fossil remains must be older than recent in age. Remains of animals currently inhabiting an area under consideration are excluded from being considered fossils, unless it can be clearly demonstrated by geologic or other scientific information that such remains are older than recent.

According to above guidelines, significant impacts occur when the scientifically significant remains of plants and animals or their traces that are older than recent in age are damaged or destroyed as a result of project implementation.

4.1.2.3 Direct and Indirect Impacts

Construction excavation associated with the development of well pad, access roads, pipelines and other production facilities could directly result in the exposure and damage or destruction of scientifically significant fossil resources. Fossils may also be destroyed in the subsurface by drilling activities, but this is thought to be a rare occurrence and insignificant when compared to the potential for destruction of fossils from surface activities. Project-related adverse impacts to fossil resources are most likely to be significant at known fossil localities or in areas underlain at or near the surface by geologic deposits with a high or unknown paleontologic potential. Deposits are considered to have a high paleontologic potential if they were known to yield scientifically significant fossils anywhere in their geographical extent. Deposits are considered to have an unknown paleontologic potential if either not enough information was known about their fossil-producing nature in the area, or their lithology, age and depositional environment suggested they should be fossil-bearing, but fossils have yet to be reported.

Adverse impacts to fossil resources are not likely to be significant in areas underlain by geologic deposits with a low paleontologic potential. Deposits are considered to have a low potential if they have been documented to lack significant fossils, or contain only non-diagnostic fragmentary fossil remains.

Beneficial impacts, including the unanticipated discovery of previously unknown fossils, could occur as a result of construction anywhere in the project area. To have beneficial impact, such newly discovered fossils must be properly collected and catalogued into the collection of a museum repository so that associated geologic data is preserved and the fossils are available for future scientific study.

4.1.2.4 Impacts Summary

Implementation of the Proposed Action and Alternatives A and B involve the development of similar surface and subsurface facilities and as a result have the potential for the same direct and indirect impacts to fossil resources. The nature of ground disturbance associated with the alternative that implements the project (Proposed Action) as well as the other alternatives is described in Chapter 2. The potential magnitude of impact to fossil resources of the alternatives varies proportionally with the total number of wells that would be developed under each alternative. Alternative C, which would allow additional APDs and ROW action on a case by case basis could also have potential direct and indirect, adverse and beneficial impacts on fossil resources. The magnitude of impact for this alternative is unknown at present and depends on the specific action taken and the specific area involved. The types of potential adverse direct and indirect impacts to fossil resources are identical for this alternative as for the others.

4.1.2.5 Cumulative Impacts

No cumulative adverse impacts to fossil resources beyond those described above are likely to occur as a result of the Proposed Action or the alternatives in combination with other ongoing activities, recently constructed project, or projects likely to be implemented in the near future. Adoption and implementation of mitigation measures described in Section 4.1.2.6 would foster long-term cumulative beneficial impacts of the project.

4.1.2.6 Mitigation Summary

Mitigation measures presented in the Soils and Water sections (4.3.6 and 4.4.6) would avoid or minimize many of the potential impacts to the geologic environment other than to paleontological resources. The following mitigation measures would prevent impacts to paleontology:

Measure 1. A BLM-approved paleontologist will complete a field inventory on a case-by-case basis for each proposed activity prior to surface disturbance in areas with known and potential significance (Class II) with regard to vertebrate paleontology and if recommended by the BLM (USDI-BLM 1987b; 1990a). Also, if paleontological resources are discovered at any time during construction, all construction activities will halt and BLM personnel will be immediately notified. Work will not proceed until paleontological materials are properly evaluated by a qualified paleontologist.

4.1.2.7 Residual Impacts

Application of prescribed mitigation measures described above should ensure that no significant adverse residual impacts to paleontologic resources occur.

4.2 AIR QUALITY

4.2.1 Introduction

Air quality impacts expected to occur from the construction and operation of the GWA II proposed action, from two separate alternatives, and from the "no action" alternative, are discussed and quantified in this section. As is the accepted procedure in assessing air quality consequences, emphasis is placed on identifying maximum, or "environmentally conservative[1]" impacts to air quality and to air quality-related values such as visibility, acid deposition, and soils and vegetation. By examining the environmentally conservative impacts, if it is found that all

[1] Errs on the side of the the environment. Also, see glossary.

projected impacts will be less than applicable significance criteria, then there is an assurance that normal and routine operation of the GWA II proposed activities will not jeopardize these air quality standards and air quality-related values.

The pollutant emissions from the Proposed Action, and from the two alternatives, would occur in two phases. For each individual well site, the first phase is a construction, drilling, and testing phase during which the well site infrastructure is built, and the wells are drilled, completed, and tested. The second phase is a production phase in which gas is extracted from the wells and routed to pipelines. Of the two phases, the construction phase is by far the larger emitter of air pollutants due to its construction vehicle traffic, drilling rig emissions, and gas flaring. During the production phase, there will be only negligible pollutant emitting activity.

The well sites would be constructed, drilled, and tested sequentially. Furthermore, there is considerable separation between individual well sites. Consequently, there would not be significant overlap between emissions from one well site and nearby well sites.

Under all alternatives except the "no action" alternative there would be four main emission-producing activities associated with each well site:

1. Construction of the access road that connects the well site to the local road. This construction activity would take about 11 days for each well site.

2. Construction of the well site pad, requiring about 11 days, and coinciding with construction of the access road.

3. Transportation of the drill rig, drill pipe, and other equipment/supplies to the well site, coinciding with rig-up, drilling, and rigging-down. This effort will require about 26 days for each well site, and will occur after access road and pad construction.

4. Well completion and testing for about 30 days, during which time gas flaring would occur for about five hours.

Dust emissions during construction activity would be minimized by use of water sprays. Dust emissions from the access road traffic would be controlled with dust suppressants as well as water spray. Pollutant emissions from the drilling engines used to bore the well hole would be minimized by proper maintenance and operation during drilling.

GWA II emission sources would have the potential to impact air quality in two distinct ways:

<u>Direct Emissions</u>. Emissions of air pollutants into the atmosphere would have a cumulative effect by contributing to increased concentrations of those pollutants. Pollutant concentrations add directly to those concentrations that already occur in the vicinity. The total magnitude of these

air pollutant concentrations must not exceed applicable ambient air quality standards, and the allowable increase in pollutant concentrations from the proposed activity alone is restricted by Prevention of Significant Deterioration (PSD) regulations.

Secondary Effects. Atmospheric pollutant concentrations can have secondary effects that may prompt impairment to visibility, harm to plants and animals (flora and fauna), or deleterious effects on surface waters caused by acid deposition.

Both of these potential air quality impacts would be eliminated, or minimized to acceptable and legal levels.

4.2.2 Impact Significance Criteria

The significance criteria for air quality include state- and federally-enforced legal requirements to ensure that ambient air pollutant concentrations remain below specified levels. These include the maximum ambient air concentrations shown in Table 4-1, and the Prevention of Significant Deterioration (PSD) increments that limit the amount of pollutant concentration increase that is allowed in certain areas, shown in Table 3-6.

4.2.3 Direct and Indirect Impacts

4.2.3.1 Proposed Action

The air quality impacts from the Proposed Action are evaluated separately for three considerations:

- Pollutant emission rates
- Air pollutant concentrations
- Air quality related values

Pollutant Emission Rates. The total pollutant emission rates expected from the construction, rig-up, drilling, completion, testing, and flaring at one well site are shown in Table 4-2 (TRC 1994). The total air pollutant emission rates from the sum of all wells would depend upon how many well locations, and how many total wells, would be developed. Assuming development of 30 wells per year, the annual emission rate of pollutants would be 30 times the emission rates shown in Table 4-2. Table 4-2 indicates that lead will be emitted in negligibly small amounts. The lead emissions would be expected to be negligibly small because there is no reason to believe that there would be any lead content in the soil disturbed by construction activity. Similarly, because there is no hydrogen sulfur in the natural gas, there will be no H_2S emissions.

Table 4-1. National and Ambient Air Quality Standards.

Pollutant	Averaging Time	National[1] Primary Standard (µg/m³)	National[1] Secondary Standard (µg/m³)	Wyoming[1] Standard (µg/m³)
TSP	24-hour	150		150
PM_{10}	24-hour	80	150	150
	Annual	365	50	50
SO_2	3-hour		1,300	1,300
	24-hour	365		260
	Annual	80		60
CO	1-hour	40,000	40,000	40,000
	8-hour	10,000	10,000	10,000
NO_2	Annual	100	100	100

[1] All standards, except annual standards, are to be exceeded no more than once per year (WDEQ 1993).

Table 4-2. Pollutant Emission Rates (tons per year) from Each Well Site.

Pollutant	Emission Rate	Threshold Level
PM_{10}	1.70	15
VOCs	0.90	40
CO	1.70	100
NO_x	23.69	40
SO_2	1.43	40
lead	nil	0.6
H_2S	nil	10

Air quality construction permits and air quality operating permits, administered and issued by the Wyoming Department of Environmental Quality, are not generally required for well pad and road construction, nor for gas well rig-up, drilling, or completion. Further, emissions from an individual gas exploration or production well and from its associated equipment are not aggregated with emissions from other wells in determining whether such units are "major" sources (sources with emissions greater than 100 tons per year (t/yr)) (WAQSR 1993). Consequently, there is no requirement for the proposed GWA II project to apply for and obtain air quality permits to construct or permits to operate.

Ambient Concentrations. Because pollutant emission rates from the well sites are smaller than threshold levels, there is no requirement that the applicant make a demonstration of compliance with ambient air quality standards or PSD increments. Nevertheless, compliance with ambient air quality standards and PSD increments is checked in this section to ensure that no significance criteria are adversely impacted.

In Table 4-3 the maximum modeled ambient air concentrations that are expected to occur during construction of well sites and roads, and during drilling and flaring operations, are compared with Wyoming Ambient Air Quality Standards (TRC 1994). The modeled concentrations shown in Table 4-3 include pollutant contributions from a single well site. Because well sites will be constructed one at a time, and because well sites would be located roughly one mile apart, there would be no appreciable interaction between construction activity or operations at the well sites. Existing neighboring sources within about 50 kilometers (31 miles) of the GWA II analysis area are included in the dispersion modeling used to predict concentrations appearing in Table 4-3. These sources include Colorado Interstate Gas Company's Desert Springs, Table Rock, and Wamsutter plants; Questar Pipeline Company's Skull Creek plant; Union Pacific Resource Company's Patrick Draw Plant; Western Gas Processors' Red Desert NGL Plant and Tipton Compressor station; Williams Field Services Monument Lake and Wamsutter Plants; and Williams Natural Gas Company's Riner Plant.

Wyoming also enforces a 24-hour total suspended particulate (TSP) ambient standard, but it is only applied to point sources whose TSP emission rates are well quantified. Because the TSP emissions from the well sites are from fugitive sources, no comparison is made with the TSP 24-hour standard in Table 4-3.

Total modeled concentrations are added to background concentrations to yield total concentration, shown in Table 4-3. All modeled concentrations are smaller than allowable Wyoming Ambient Air Quality Standards (WAAQS).

To check compliance with Prevention of Significant Deterioration (PSD) increments requires cumulative modeling of all sources' emission increases since the particulate matter, SO_2, and NO_2 baseline dates to determine how much of the available increment is consumed. Modeled TSP, SO_2, and NO_2 concentrations in the vicinity of the GWA II proposed plant are compared with

Table 4-3. Comparison of Modeled Concentrations with WAAQS (μg/m³).

Pollutant	Modeled Concentration	Background Concentration	Total Concentration	Wyoming Standard
NO_2				
Annual	6.1	3	9.1	100
PM_{10}				
24-hour	100.6	45	145.6	150
Annual	0.7	12	12.7	50
CO				
1-hour	137.0	3,500	3,637.0	40,000
8-hour	57.8	1,500	1,557.8	10,000
SO_2				
3-hour	75.0	63	138.0	1,300
24-hour	34.1	32	66.1	260
Annual	0.4	2	2.4	60

Table 4-4. Comparison of Modeled Concentrations with Class II PSD Increments.

Pollutant	Modeled Concentration (μg/m²)	Class II PSD Increment (μg/m3)
NO_x		
Annual	6.1	25
SO_2		
Annual	0.4	20
24-hour	34.1	91
3-hour	75.0	512

Class II PSD increments in Table 4-4 (TRC 1994). These concentrations indicate that the applicant's proposed natural gas facilities will not prompt an exceedance of available Class II PSD increments. Particulate matter emitted during temporary construction activities (including construction of the access road and well site pad) is exempt from PSD increment consumption under both federal EPA regulations (EPA 1990) and Wyoming Department of Environmental Quality regulations (WAQSR 1993). Consequently, the TSP increment consumption is not shown in Table 4-4. The federal EPA has adopted PM-10 PSD increments (EPA 1993), but they will not be implemented in Wyoming until rule-making has been effected, and until EPA approves Wyoming rules.

The nearest Class I areas to the proposed GWA II natural gas well sites are the Bridger/Fitzpatrick Wilderness Areas. Modeled NO_2, SO_2 and TSP concentrations from the natural gas wells are far less than allowable Class I PSD increments. The maximum modeled annual NO_2 concentration at the wilderness areas is 0.1 $\mu g/m^3$, less than the Class I increment of 2.5 $\mu g/m^3$. Similarly, the maximum modeled TSP concentration contributions are less than Class I increments: the annual average TSP contribution is less than 0.01 $\mu g/m^3$, smaller than the increment of five $\mu g/m^3$; and the second-high TSP contribution is less than 0.01 $\mu g/m^3$, smaller than the 10 $\mu g/m^3$ PSD increment. The modeled annual, 24-hour, and 3-hour SO_2 concentrations are 0.01 $\mu g/m^3$, 0.31 $\mu g/m^3$, and 1.8 $\mu g/m^3$, smaller than the applicable SO_2 increments (2 $\mu g/m^3$, five $\mu g/m^3$, and 25 $\mu g/m^3$, respectively). These findings indicate that the proposed plant would meet PSD ambient air concentration criteria.

4.2.3.1.1 Air Quality-Related Values

An analysis of impairment to air quality-related values (AQRVs) includes assessment of the air pollution impact to visibility, surface waters (via acid deposition), and soils/vegetation.

Visibility. One form of visibility impact assessment examines whether an air pollutant "plume" from an emission source would be detectable, or "visible," at the nearest Class I area. The criteria for "visible" in this instance is based on the relative contrast between the plume/sky, and the plume/terrain. Computations of contrast are made using the EPA's VISCREEN I computer model (EPA 1994), which makes very conservative assumptions about the meteorological conditions that transport the plume to the Class I area, and about the reflectivity and light absorption of the plume when viewed against the sky or nearby terrain. Results of the VISCREEN model are expressed in terms of extinction (Delta E) and Contrast. Table 4-5 shows that all measures of plume visibility at the nearest Class I area, the Bridger Wilderness, are smaller than allowable visibility criteria. This indicates that the plume from the applicant's proposed well sites would not be visible from either inside the wilderness (looking out towards the wells) or outside the wilderness (looking in towards the wilderness).

A second kind of visibility impairment is reduction in visual range, or how far away a person can "see" a distant object. Reductions in visual range are caused by small particle-induced light scattering, and light scattering or absorption from secondary pollutant species such as NO_x, nitrates and sulfates. The degree to which the visual range is reduced is determined by the Koschmieder equation, which computes the fractional decrease in visual range, combined with assumptions of environmentally conservative particle density, mass median diameter, and distribution of particle density, mass median diameter, and distribution of particle sizes. Choosing values of these parameters that will maximize the reduction in visual range, and making assumptions about the prevailing meteorology (500 meter mixing height and 1.0 meter/sec wind speed), indicates that the reduction in visual range will be 0.003 percent (TRC 1994), much smaller than the commonly accepted limit of perceptible visual range reduction of five percent (EPA 1980).

Table 4-5. Visual Effects Screening Analysis Results.

Viewer Location	Background	Delta E		Contrast	
		criteria	plume	criteria	plume
Inside	Sky	2.00	0.070	0.5	-0.001
	Terrain	2.00	0.015	0.5	0.000
Outside	Sky	2.00	0.073	0.5	-0.001
	Terrain	2.00	0.030	0.5	0.000

Deposition. Acid deposition (acid rain) is a complicated phenomenon in which primary gaseous pollutants are transformed into secondary pollutants (sulfates and nitrates), and are deposited on the ground and in bodies of water in the form of weak acids. Acid deposition can have deleterious effects on water quality and on aquatic life in the lakes. Certain lakes in the Bridger Wilderness have been identified as being potentially sensitive to acidic deposition with measured alkalinities of less than 200 micro-equivalents per liter (μeq/l).

Sulfur dioxide and nitrogen dioxide emitted from the proposed GWA II well sites would transform into sulfates and nitrates, and then convert to weak acids. Acid deposition rate computations are based on equations recommended by Fox (1983), and yield annual average deposition as a function of 1) airborne concentration over the watersheds, and 2) acid deposition velocity. Implicit in the computations are the assumptions that the plume transport trajectory from the applicant's proposed well sites to the target watersheds follows a straight line and is unimpeded by terrain; that all NO_2 is converted directly and completely to its strong acid form; that wet deposition is equal in magnitude to dry deposition; and that no depletion of the plume occurs prior to reaching the watershed, at which point all of the pollutant is immediately transformed. With these assumptions, acid fluxes are computed at three of the most sensitive lakes in the Bridger Wilderness. Annual average nitrogen and sulfur deposition (flux) calculated from the proposed GWA II well sites is shown in Table 4-6. The pH change and the acid neutralizing capacity (ANC) change that could occur as a result of these fluxes is also calculated and appears in Table 4-6 (TRC 1994).

The change in pH at all lakes and watersheds is less than the significant criteria of 0.1 pH, and the change in ANC is less than 10 percent, indicating that no adverse acid deposition effects are expected as a result of the proposed well site construction and operation.

Table 4-6. Input Variables and Results of pH and ANC Change Computations.

Lake/ Watershed	Existing ANC (μeq/l)	Nitrogen Flux (kg/ha-yr)	Sulfur Flux (kg/ha-yr)	Change in pH	Change in ANC (%)
Klondike	20	0.0076	0.0018	0.00118	0.27
Titcomb	34	0.0076	0.0018	0.00070	0.16
Blackjoe	7	0.0123	0.0029	0.00055	0.13

Soils and Vegetation. Impairment to soils and/or vegetation as a result of air pollutants is indicated first by vegetation damage. Numerical air quality thresholds have been developed for various plant species that indicate the susceptibility of plants to poor air quality exposure. Consequently, if concentrations are sufficiently low to ensure that no vegetation damage will occur to even the most sensitive species, then they are low enough to protect soils as well as the less sensitive plants such as lichens. Table 4-7 identifies these plants susceptible to NO_2 (EPA 1979). Of these species, only lichens occur within the GWA II analysis area.

The NO_2 concentrations and associated time durations for various plants that appear in Table 4-7 are the observed exposure times over which NO_2, at the indicated concentrations, causes plant injury. The reason that several different plant species and different time durations were reported in Table 4-7 is that different plants respond in different ways, over varying exposure times, to NO_2. The U.S. EPA's extensive review of the available literature regarding plant damage from NO_2 (EPA 1979) states that:

> " . . . Because of the inter-relationship between concentration and time, there is no single threshold dose for an effect."

The different species (tomatoes, oranges, endive, cotton, and lichens) included in Table 4-7 of the EIS span the full exposure range from 0.25 days (6 hours) to 128 days (3,072 hours) at which various NO_2 concentrations prompt plant damage. Only the most susceptible species are shown in Table 4-7. By examining threshold concentrations/exposure times for these most susceptible species, there is assurance that none of the less sensitive vegetation will be adversely affected.

Although the EPA study cited (1979) does not present data specifically for sagebrush, rabbitbrush, nor native grasses, it does appear to be the most extensive scientific compilation of effects on vegetation that is available. It reviews and considers findings from 105 different research studies world-wide, and uses the findings concerning the most susceptible species to draw conclusions about NO_2 threshold concentrations/exposure for "vegetation in general."

Table 4-7. Summary of NO_2 Plant Damage Exposure and Concentrations.

Plant	Concentration (μg/m³)	Exposure (days)
Tomato *(Lycopersicon esculentum)*	470	128
Navel Oranges	470	240
Endive *(Cicorium endive)*	1,880	2
Cotton *(Gossypium hirsutum)*	1,880	2
Lichens	3,960	0.25

To convert annual average concentrations to short-term 1-hour concentrations, the long-term values can be multiplied by 10 (EPA 1977). Because the maximum modeled annual average NO_2 concentration in the vicinity of the proposed well sites plant is expected to be 9.1 $\mu g/m^3$, the greatest short-term concentration would probably not exceed 91 $\mu g/m^3$. Because this short-term concentration is smaller than all of the vegetative criteria shown in Table 4-7 no vegetation damage would be expected as a result of construction and/or operation of the applicant's gas well sites.

4.2.3.2 Alternative A

Under Alternative A, the GWA II operators would be allowed to develop 300 wells at 250 well sites in addition to the existing operations within the GWA II analysis area. As with the applicant's proposed action, Alternative A would not cause exceedances of the air quality significance criteria. Maximum, localized ground level air pollutant concentrations under Alternative A would not be appreciably different than those associated with the applicant's proposed action because each individual well site would still exhibit concentrations of the magnitude shown in Table 4-3 However, the total mass of pollutants emitted to atmosphere would be less than under the applicant's proposed action because there would be fewer well sites constructed and operated.

4.2.3.3 Alternative B

Under Alternative B, the GWA II operators would be allowed to develop 200 well sites with 225 wells in addition to the existing operations within the GWA II analysis area. Alternative B would not cause exceedances of the air quality significance criteria. As with Alternative A, maximum localized ground level air pollutant concentrations under Alternative B would not be appreciably less than those associated with the applicant's proposed action.

4.2.3.4 Alternative C - No Action

Under Alternative C, the "No Action" alternative, the ongoing natural gas production activities would be allowed to continue in the GWA II analysis area, but the proposed full field development, as well as other development alternatives, would be disallowed. Air pollutant emissions from existing sources would continue, but no exceedances of significance criteria would occur.

4.2.4 Impacts Summary

The construction and operation of additional well sites in the GWA II analysis area as proposed by the applicant, or as proposed under Alternatives A and B, would not have significant air quality impact. The airborne pollutant concentrations that would result from the increased well site emissions would meet all Wyoming and federal ambient air quality standards, and would comply with applicable PSD increments. Likewise, the impact to air quality-related values (visibility, acid deposition, and soils/vegetation) would be below significance criteria levels.

4.2.5 Cumulative Impacts

The air quality impacts prompted by the applicant's proposed action, and by Alternatives A and B, would add to the existing air quality impacts already caused by pollutant sources currently located in the area. The air quality impacts shown in Table 4-3 reflect the cumulative impact of the proposed new well sites, existing well sites, and background concentration. These cumulative impacts fully comply with the allowable Wyoming air quality standards.

4.2.6 Mitigation Summary

Given the incorporation of air pollutant mitigation measures identified in Chapter 2 (Section 2.3.4.2.1, Air Quality) into the Proposed Action, no additional mitigation measures would be needed to address impacts to air quality.

4.2.7 Residual Impacts

Other than the impacts described and quantified above, there would be no residual impacts.

4.3 SOILS

4.3.1 Introduction

Impacts resulting from drill pad, access road, facility site, and pipeline ROW construction could include removal of vegetation, exposure of the soil, mixing of soil horizons, soil compaction, loss of topsoil productivity, and increased susceptibility of the soil to wind and water erosion.

4.3.2 Impact Significance Criteria

The Great Divide RMP (USDI-BLM 1990a) prescribes the following objectives and actions relative to soils and watershed management that relate to this project:

- Maintain soil cover and productivity where they are adequate;

- Increase soil cover and productivity where these are declining;

- Implement intensive practices to mitigate salt and sediment loading;

- Administer watershed management practices designed to meet soils, water, and air resource management objectives;

- Prohibit surface disturbing activities on unstable areas unless it can be demonstrated that the instability can be alleviated. Specific unstable areas such as landslides, slumps, and areas exhibiting soil creep will be individually identified; and

- Prohibit surface disturbance in areas with topographic slopes greater than 25 percent and precluding construction in frozen soils or during periods when soil material is saturated or when watershed damage is likely to occur.

Given the management objectives in the RMP (USDI-BLM 1990a) and as itemized above, the following criteria were used to determine the importance of impacts to soils within the GWA II analysis area:

- non-compliance with the RMP;

- increased soil erosion that cannot be reduced by 50 percent after one year and by 75 percent after five years of soil disturbance;

- failure to have successful revegetation within three to five years of implementation;

- a reduction in soil productivity to a level that minimizes or prevents the disturbed area from recovering to pre-disturbance soil productivity levels;

- location and construction of project facilities on sensitive soils (soils having one or more of the following characteristics: difficult reclamation potential, high erosion hazard, slope gradients greater than 40 percent, and moderate to high stability hazard) without the use of special construction methods; and

- the proposed project would increase the total cumulative soil disturbance within the GWA II analysis area to more than a total of 10 percent of the GWA II analysis area and/or to more than a total of three percent for the cumulative impact area (i.e., USGS delineated watersheds crossed or covered by the GWA II analysis area).

4.3.3 Direct and Indirect Impacts

4.3.3.1 Proposed Action

The project activities listed above could result in adverse impacts to soils including the removal of vegetation, exposure of the soil, mixing of soil horizons, soil compaction, loss of topsoil productivity, and increased susceptibility of the soil to wind and water erosion. These impacts could increase runoff, erosion, and off-site sedimentation. As described in the Soils section of Chapter 3, (Section 3.5) approximately 94 percent of the GWA II analysis area falls into a sensitive soils category in regard to topsoil depth and quality, with limitations to road and facilities construction, rapid to very rapid runoff potential, and severe to very severe wind and water erosion potential. Prime farmland soils as well as farmland soils of state and local importance do not occur in the project area and therefore, would not be adversely affected by the project. Because sensitive soil mapping units are distributed throughout the GWA II analysis area, total avoidance of these sensitive areas would not be possible. Special mitigation would be required to keep adverse impacts to an acceptable level. The distribution and location of the sensitive soil mapping units is presented in the Soils and Water Resources Technical Report (ECOTONE 1995c).

Construction of the Proposed Action would variously disturb approximately 2,416 acres of soils. This total would include 1,500 acres for drill sites and associated facilities (assuming 5.0 acres of disturbance per drill pad), 909 acres for combined pipeline/access road ROWs (assuming 3.03 acres per well, and a seven-acre compressor station). Once a well goes into production, the size of the drill pad can be reduced. The unused portion of the drill pad would be reclaimed as described in Section 2.3.3.5 of Chapter 2. Similarly, a portion of the combined roadway/pipeline construction ROW would be reclaimed upon production. Assuming all wells are productive, the total area of impact would be reduced upon successful reclamation to approximately 1,364 acres including 630 acres for well pads (2.1 acre per pad) and 727 acres for road/pipeline ROW. These disturbance would be combined with the existing disturbance of approximately 12,530 acres, or 3.7 percent of the project area. Therefore, total cumulative soil disturbance in the analysis area, not taking reclamation into consideration, would be approximately 14,943 acres or 4.5 percent of the area. This total disturbance would not exceed the significance criteria presented above.

Increased susceptibility to erosion would occur in newly disturbed areas. Soil compaction caused by equipment traffic or by increased raindrop impact after loss of surface cover may decrease infiltration and water storage capacity, increase runoff, and reduce soil productivity. Increased surface runoff and erosion would occur primarily in the short term and would decline in time due to natural stabilization. Increases in surface runoff would also depend on the success of mitigation measures.

If handled incorrectly, the removal of topsoil for revegetation purposes could reduce the natural fertility of the soil or cause coarse fragments from the subsoil to be mixed into the topsoil, decreasing its reclamation potential. This in turn could inhibit reclamation success such that successful reclamation may not be completed in three to five years.

Topsoil quality in the GWA II analysis area is fair to poor due to stoniness, salts, thin soils, very sandy soils, droughtiness, and soils with high coarse fragment content (Table 3-8). Subsequently, revegetation potentials range from mostly fair to poor, with some areas rated as good. In addition to these limitations, low annual precipitation and wind and water erosion could make successful reclamation in the GWA II analysis area more difficult to attain. Therefore, the overall potential for successfully stabilizing disturbed soils is fair to poor.

Since specific sites have not yet been identified for wells, pipelines, and roads, Table 3-8 indicates the likelihood of encountering soil limitations that will require special attention. A large portion of the project area would likely experience difficulties during revegetation due to the presence of excess sodium and/or clay in the soil. In addition, the droughty nature of the soils would further limit the soils' reclamation potential. Excessive sand and wetness would be avoided by final siting choices.

Slopes rated slightly severe or greater occupy nearly one-fifth of the overall area. In nearly half of the instances of severe slope, shallow depth to rock and/or high sand content may be anticipated as a further complication.

Indirect impacts from off-road use of vehicles include vegetal cover destruction, as well as rutting and compaction of the soil. Given the sensitivity of the soils indicated in Table 3-8, unauthorized off-road vehicle use should be restricted.

These potential adverse impacts of the proposed project could reduce soil productivity, impair successful revegetation, and result in increased erosion potential. Successful revegetation through applied surface runoff, erosion, and sediment control measures, and effective revegetation efforts applied surface runoff, erosion, and sediment control measures, and effective revegetation efforts would reduce the potential for soil productivity loss. Soil erosion is likely to be a primary adverse impact of these project effects. Erosion can impede successful revegetation, result in a loss of site productivity, and impair water quality if eroded sediment is transported to surface water bodies. Some soils and geologic units may have relatively high levels of selenium. Erosion of selenium-laden sediment could increase selenium loading of streams.

Existing literature estimates soil loss tolerance within the general area of the GWA II at 2.0 tons/acre/year (t/ac/yr); losses exceeding this amount would lower soil productivity (USDI-BLM 1987a). In regard to general soil erosion, most sediment is generated from exposed areas that cover only a small portion of the project area. As discussed in Water Resources, Section 3.4 of Chapter 3, sediment delivery has been estimated to be approximately 0.28 ac-ft per square mile per year or 1.0 t/ac/yr. The majority of sediment delivery originates from erosion and degradation of stream channels as opposed to soil erosion away from channels.

Given the potential importance of soil erosion, the Universal Soil Loss Equation (USLE) (USDA-FS 1980) was used to evaluate land management practices and the potential soil erosion in the GWA II analysis area. This equation was originally developed by Wischmeir and Smith (1965) but was adapted specifically for roads (Israelson et al. 1980). Natural baseline erosion was estimated to be approximately 0.7 t/ac/yr. This is an environmentally conservative estimate, and the true natural baseline erosion rates are likely less than the value presented here. This magnitude correlates with the BLM's estimate of 1.0 t/ac/yr. Most of the predicted eroded soil is contained on-site and is not transported off-site to streams.

Applying the same technique to newly disturbed soils, the average unmitigated erosion rate could be as high as three t/ac/yr for drill pads, 18 t/ac/yr for pipelines, and 10 t/ac/yr for roads. New project facilities would be constructed with surface runoff, erosion, and sedimentation controls in place that would reduce erosion rates. The effect of applying control measures to reduce erosion was investigated by Grah (1989) through the use of the Universal Soil Loss Equation (USLE) to demonstrate the feasibility of erosion reduction. Control measures include the use of mulch, water bars, and effective revegetation. Applying control measures and assuming a reasonable success rate, erosion from newly disturbed areas could be reduced to two, five, and three t/ac/yr in the first year for drill sites, pipelines, and roads, respectively. As discussed previously, erosion would continue to decrease due to natural stabilization and a maturing vegetal cover. By the fifth year after construction, erosion would likely be reduced to one, two, and two t/ac/yr for well, pipelines, and roads, respectively. This represents a 67 percent reduction for well sites, 89 percent reduction for pipelines, and an 80 percent reduction for roads. Erosion reductions for well sites and roads would not decrease as much as for pipelines since exposed earth material that comprise the surface of these features would continue to be exposed to erosion. These calculations suggest that soil erosion could be reduced to non-significant levels identified in the significance criteria with application of the control measures recommended in Appendix B.

Table 4-8 summarizes total erosion that could occur under this alternative with and without erosion control measures. With the application of erosion control measures, total erosion from the Proposed Action would be approximately 6,649 tons per year after the first year of construction and 3,325 tons after the fifth year. These estimates assume that all construction would occur in the first year of project authorization. As discussed in Chapter 2, project development would occur over a two-year period from 1994 through 1996. Therefore, the total estimated erosion would be distributed over this period of time and would be less than the environmentally conservative analysis.

Wind erosion could also be an adverse effect of project development. However, wind erosion is not expected to be a widespread problem across the GWA II analysis area. Chronic and severe wind erosion could occur in limited areas where roads and/or pipelines traverse sand dune soils. Because these areas are particularly susceptible to "blow outs," special efforts to avoid such areas should be applied. Where avoidance is not feasible, special erosion control and soil stabilization measures should be applied as discussed in Appendix B.

Of particular importance in regards to potential soil impacts will be soils with high water tables and/or surface inundation. Bearing strengths in these soils is generally low and facilities placed in such areas could be subjected to damage. Such areas are depicted in Exhibit 3-2 that shows areas of wetlands and other surface water features. Placement of project facilities will need to avoid these areas. In order to preclude significant impacts, roads, drill/well sites, and pipelines should not be placed in areas with steep slopes greater than 30 percent, areas with badland soils or sand dune soils. Therefore, significant impacts are not expected to occur with implementation of the Proposed Action.

4.3.3.2 Alternative A

Implementation of Alternative A would involve fewer acres of construction impacts (a total of approximately 2,015 acres) than the Proposed Action. This total acreage would be comprised of 1,250 acres for drill pads and 757.5 acres for road/pipeline ROW. Production phase impacts would be reduced from the initial construction phase and would be approximately 525 acres for well pads and 389 acres for road/pipeline ROW, or a total of 905 acres. These disturbance areas would represent approximately 0.6 percent of the total project area. This disturbance would be combined with the existing disturbance of approximately 12,530 acres. Therefore, total cumulative soil disturbance in the project area would be approximately 14,545 acres or 4.2 percent of the project area. This total disturbance would not exceed the significance criteria presented above in subsection 4.4.2.

Table 4-8. Soil Erosion Rates and Total Erosion by Alternative.

		Year 1		Year 5	
		Erosion rates (t/ac/yr)			
Facility	Area (acres)	Without Erosion Control	With Erosion Control	Without Erosion Control	With Erosion Control
Well Pads	--	3	2	2	1
Compressor Station	--	3	2	2	1
Pipelines	--	18	5	4	2
Roads	--	10	1	2	2
Predicted Erosion (t/yr)					
Proposed Action (t/yr)					
Well Pads	1,500	4,500	3,000	3,000	1,500
Compressor Station	7	21	14	14	7
Pipelines	454	8,172	2,270	1,816	908
Roads	455	4,550	1,365	3,640	910
TOTAL	**2,416**	**17,243**	**6,649**	**8,470**	**3,325**
Alternative A (t/yr)					
Well Pads	1,250	3,750	2,500	2,500	1,250
Compressor Station	7	21	14	14	7
Pipelines	379	6,822	1,895	1,516	758
Roads	379	3,790	1,137	3,032	758
TOTAL	**2,015**	**14,383**	**5,546**	**7,062**	**2,773**
Alternative B (t/yr)					
Well Pads	1,000	3,000	2,000	2,000	1,000
Compressor Station	7	21	14	14	7
Pipelines	303	5,454	1,515	1,212	606
Roads	303	3,030	909	2,424	606
TOTAL	**1,613**	**11,505**	**4,438**	**5,650**	**2,219**

The same types of soils impacts would occur under this alternative as with the Proposed Action. The amount and duration of such impacts would depend on the locations of the wells and access roads. As discussed previously, it would be very difficult to totally avoid all sensitive soil areas. Slopes greater than 30 percent, badland soils, and sand dune soils should be totally avoided. Therefore, where the other sensitive soils cannot be avoided, special construction techniques and mitigation measures should be applied to reduce the probability of significant soils impacts.

Erosion rates would be essentially the same for this alternative as for the Proposed Action since the same types of construction activities would occur. However, total erosion would be reduced due to the smaller area of disturbance under this alternative. Table 4-8 summarizes total erosion that could occur under this alternative with and without erosion control measures. With the application of erosion control measures, total erosion under this alternative would be approximately 5,546 tons per year after the first year of construction and 2,773 tons after the fifth year. These estimates assume that all construction would occur in the first year of project authorization. As discussed in Chapter 2, project development would occur over a two-year period from 1994 through 1996. Therefore, the total estimated erosion would be distributed over this period of time and would be less than the environmentally conservative analysis. These calculations suggest that soil erosion could be reduced to non-significant levels identified in the significance criteria with application of the control measures itemized in Appendix B. Therefore, significant impacts are not expected to occur with implementation of Alternative A.

4.3.3.3 Alternative B

Implementation of Alternative B would involve fewer acres of construction impacts than the Proposed Action or Alternative A, for a total of approximately 1,613 acres. This total would be comprised of 1,000 acres for drill pads, 606 acres for road/pipeline ROW, and seven acres for the compressor station. Production phase impacts would be reduced from the initial construction phase and would be approximately 420 acres for well pads and 304 acres for road/pipeline ROWs, or a total of 724 acres. These disturbance areas would represent approximately 0.5 percent of the total analysis area. This disturbance would be combined with the existing disturbance of approximately 12,530 acres. Therefore, total cumulative soil disturbance in the project area would be approximately 14,160 acres or 4.1 percent of the project area. This total disturbance would not exceed the significance criteria presented above.

The same types of soils impacts would occur under this alternative as with the Proposed Action. The amount and duration of such impacts would depend on the locations of the wells and access roads. As discussed previously, it would be very difficult to totally avoid all sensitive soil areas. Slopes greater than 30 percent, badland soils, and sand dune soils should be totally avoided. Therefore, where the other sensitive soils could not be avoided, special construction techniques and mitigation measures should be applied to reduce the probability of significant soils impacts.

Erosion rates would be essentially the same for this alternative as for the Proposed Action since the same types of construction activities would occur. However, total erosion would be reduced due to the smaller area of disturbance under this alternative. Table 4-8 summarizes total erosion that could occur under this alternative with and without erosion control measures. With the application of erosion control measures, total erosion under this alternative would be approximately 4,438 tons per year after the first year of construction and 2,219 tons after the fifth year. These estimates assume that all construction would occur in the first year of project authorization. As discussed in Chapter 2, project development would occur over a two-year period from 1994 through 1996. Therefore, the total estimated erosion would be distributed over this period of time and would be less than the environmentally conservative analysis. These calculations suggest that soil erosion could be reduced to non-significant levels identified in the significance criteria with application of the control measures itemized in Appendix B. Therefore, significant impacts are not expected to occur with implementation of Alternative B.

4.3.3.4 Alternative C - No Action

Under the No Action Alternative, soils would continue to be impacted as described above under the action alternatives as APDs are granted by the BLM pursuant to previous authorizations. Similar erosion, runoff, and sediment control and revegetation measures would be applied to minimize adverse impacts to soils. Such methods, if implemented properly, would likely reduce impacts to non-significant levels. This undefined continued development would add to the existing disturbance in the GWA II analysis area of approximately 12,530 acres. Using the same erosion estimation procedures summarized previously, existing erosion could be as high as 3.0 t/ac/yr or approximately 37,590 t/yr. Such development would likely be similar to Alternative B in regard to magnitude with similar impact levels. The increase in erosion due to additional development activity would also be similar to Alternative B. Therefore, significant impacts are not expected to occur with implementation of the No Action alternative.

4.3.4 Impact Summary

Implementation of the Proposed Action and action alternatives (A and B) would initially affect 2,416 acres, 2,015 acres, and 1,613 acres of soils, respectively, during project construction. This would represent approximately 0.7 percent, 0.6 percent, and 0.5 percent of the total GWA II area for the Proposed Action, Alternative A, and Alternative B, respectively. Reclamation efforts during well production would reduce respective impacts to 1,086 acres, 905 acres, and 724 acres respectively. Impacts resulting from drill pad, access road, facility site, and pipeline ROW construction could include removal of vegetation, exposure of the soil, mixing of soil horizons, soil compaction, loss of topsoil productivity, and increased susceptibility of the soil to wind and water erosion. These impacts could increase runoff, erosion, and off-site sedimentation. Total erosion that could result from the proposed project was estimated to be approximately 6,649 t/ac for the Proposed Action, 5,546 t/ac under Alternative A, and 4,438 t/ac under Alternative B. This erosion would be in addition to the natural baseline erosion as well as the erosion occurring due to existing disturbance in the GWA II analysis area. Although, the majority of the GWA II analysis area is classified as sensitive soil and such areas cannot be totally avoided, particular attention should be given to avoiding steep slopes greater than 30 percent, badlands, and soils with high water tables and/or which are subject to inundation and thus, minimize the chance of a significant impact. These impacts could be kept to non-significant levels with application of the mitigation measures in Chapter 2 and the control measures recommended in Appendix B.

4.3.5 Cumulative Impacts

Cumulative impacts include soil impacts from ongoing activities, recently constructed projects, and projects likely to be implemented in the near future (i.e., reasonably foreseeable future actions or RFFA). Cumulative impacts can be divided into two geographic areas including those within the GWA II analysis area and those occurring outside of the GWA II analysis area. A detailed analysis of existing disturbance within the GWA II analysis area and the cumulative impacts analysis (CIA) area is presented in the Soils and Water Resources Technical Report. Recent BLM guidance strongly recommends that natural resources that relate to watershed function and stability be evaluated for cumulative impacts on a watershed basis (USDI-BLM 1994c). Thus, the cumulative impacts area (CIA) for soils includes two components: 1) the GWA II analysis area, and 2) all watersheds as designated by the USGS that are overlapped by the GWA II analysis area. Exhibit 4-1 depicts the location and relationship of the GWA II analysis area and the considered watersheds.

GWA II Analysis Area. Existing disturbance within the GWA II analysis area was identified, delineated, and mapped using aerial photographs taken in May of 1994 as described in detail in the Soils and Water Resources Technical Report. Disturbance areas were digitized into a Geographic Information System (GIS) for data manipulation and analysis using GIS software. Existing disturbance within the GWA II analysis area, as discussed in Section 2.7.2., is approximately 12,527 acres, or around 3.7 percent of the 334,191 acres comprising the GWA II analysis area. During the construction phase, the Proposed Action would add 2,416 acres of impact for a cumulative area of 14,943 acres (4.5 percent). Alternative A would increase existing disturbance by 2,015 acres to 14,542 acres (4.4 percent). Alternative B would produce 1,613 acres of new impact for a total of 14,140 acres (4.2 percent). Under Alternative C, additional surface disturbance beyond the existing 12,527 acres would occur on a case-by-case basis. It is anticipated that such impact would be between 3.7 and 4.5 percent of the GWA II analysis area.

Impacts within the GWA II analysis area would be reduced upon reclamation of pipeline ROWs and unused portions of the drill pads during the production phase for each alternative. Under the Proposed Action, reclamation would reduce impacts by 1,052 to 1,364 acres for a cumulative impact of 4.2 percent of the GWA II analysis area. Alternative A impacts would decrease by 877 to 1,138 acres, with cumulative impacts affecting 4.1 percent of the GWA II analysis area.

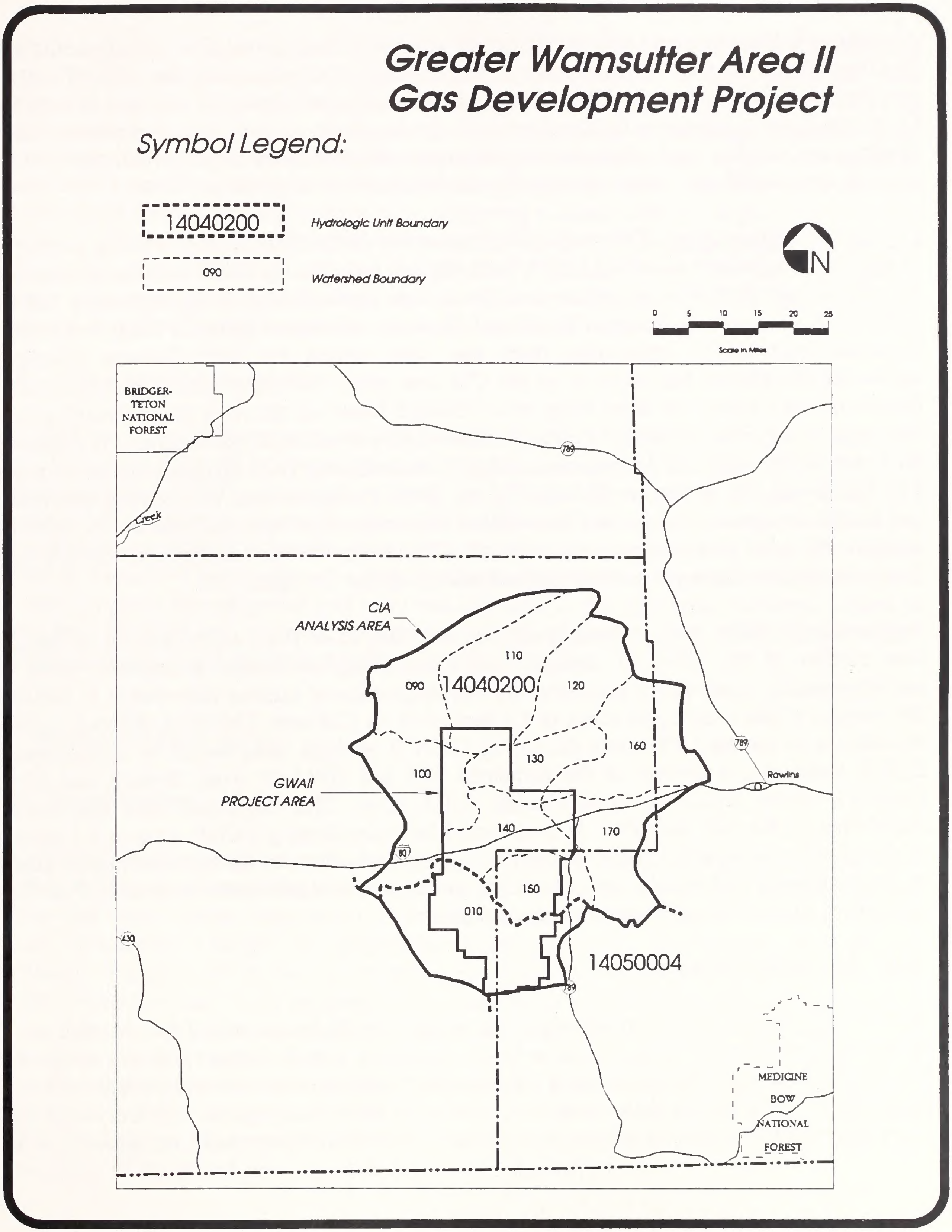

Exhibit 4-1. Watershed Boundaries Used in the Cumulative Impacts Analysis (CIA).

Alternative B impacts would drop by 701 to 912 acres; therefore, cumulative impacts would drop to 4.0 percent of the GWA II analysis area. The cumulative impacts within the GWA II analysis area include Colorado Interstate Gas's Uinta Basin Lateral pipeline project, the Echo Springs Gas Gathering System, other gas field and resource development activities, and disturbances due to previous unimproved roads. As indicated previously, the cumulative impact within the GWA II analysis area would not exceed the significance threshold of 10 percent.

Cumulative Impacts Area. The geographic area outside of the GWA II analysis area considered in the CIA was defined following USDI-BLM (1994d) based on the USGS delineated watershed boundaries that the GWA II analysis area covered or touched, an area approximately 780,440 acres in size. This area is shown in Exhibit 4-1. Existing disturbance in the CIA area was initially estimated from USGS topographic maps that were current for 1985. Because significant additional disturbance has occurred in the CIA area since the maps were published, existing disturbance not shown on those maps was estimated based on the level of additional activity measured in the GWA II analysis area as evidenced from the aerial photographs. A portion of the Creston/Blue Gap field development project, Carbon County UCG Program, and the Uranium Mill Site project fall within the CIA area for the GWA II analysis area. The existing disturbance and future disturbance due to the Creston/Blue Gap project has been included in the following analysis. No other permitted projects within the CIA area are evident at this time. The Mulligan Draw and Patrick Draw projects are located outside of the CIA area.

Approximately 4,403 acres of disturbance was estimated as of 1985, or 0.6 percent of the CIA area outside of the GWA II analysis area. Correcting for current disturbance using an environmentally conservative approach, the true magnitude of existing disturbance is probably 200 percent of this total, 8,806 acres, or 1.2 percent of the CIA area. Therefore, the total existing disturbance in the total CIA area (including GWA II analysis area) would be approximately 21,333 acres, or 1.9 percent of the combined CIA and GWA II areas. Impacts due to the Proposed Action would be approximately 2,416 acres. This combined with the existing disturbance in the CIA and GWA II areas would be approximately 23,749 acres or 2.1 percent of the combined area of 1,114,630 acres. This analysis indicates that the total cumulative impact in the combined CIA would not exceed the three percent significance threshold. Therefore, cumulative impacts to soils would not be significant.

4.3.6 Mitigation Summary

As with any adverse impact, avoidance of the impact should be considered first. Avoidance of particularly sensitive soil areas should be given attention in both the project planning and project construction phases. Particular sensitive soil areas that would require avoidance include sand dune areas, steep slopes greater than 40 percent, areas with little or no topsoil, and areas with high water tables and/or which are subject to inundation. As indicated previously, the majority of the

GWA II analysis area is comprised of sensitive soils including those particular soils mentioned above. The other sensitive soils should also be avoided where feasible; however, given their wide distribution and area covered, such total avoidance would likely not be feasible. Therefore, special measures or best management practices would need to be implemented to minimize the chance of significant impacts resulting from construction in sensitive soils. Appendix B identifies recommended measures that should be considered in minimizing adverse impacts. Such measures include careful construction and performance monitoring to ensure effective application of control measures. These measures primarily address the issues of surface runoff, erosion, and sedimentation control as well as effective revegetation of disturbed areas. Incomplete application of these measures, where needed, could result in failed erosion control and revegetation. Such measures, if applied, would reduce the chance of significant impacts occurring.

4.3.7 Unavoidable Adverse Impacts

No significant unavoidable adverse impacts to soils would occur due to the Proposed Action or other alternatives with the implementation of mitigation stipulations identified in the Resource Management Plan (RMP), measures proposed by UPRC as presented in Chapter 2, and the recommended measures presented in Appendix B. Although successful surface runoff, erosion, and sedimentation control is feasible on most of the soils in the project area, there is a residual chance of ineffective application of control measures. Significant unavoidable adverse impacts are unlikely given the mitigation and measures available to the operators. However, failure to apply best management practices during the planning, construction, and/or performance monitoring phases could result in significant localized impacts.

4.4 WATER RESOURCES

4.4.1 Introduction

Potential impacts that could occur due to project implementation include increased surface water runoff and off-site sedimentation due to soil disturbance (see Soils Section 3.3); increased salt loading and water quality impairment of surface waters; changes in stream discharge due to project disturbance; changes in groundwater levels, quantity, and quality; and channel morphology changes due to road and pipeline crossings. The magnitudes of impacts to water resources would depend on the proximity of the disturbance to the drainage channel, slope aspect and gradient, degree and area of soil disturbance, soil character, duration of time within which construction activities would occur, and the timely implementation and success/failure of mitigation measures. Impacts would likely be greatest shortly after the start of construction activities and would likely decrease in time due to natural stabilization, reclamation, and revegetation efforts. Construction activities would occur over a relatively short period; therefore, the majority of the disturbance would be intense but short-lived.

4.4.2 Impact Significance Criteria

The Great Divide RMP (USDI-BLM 1990a) prescribes the following objectives and actions relative to water resources and watershed management that relate to this project:

- Controlling flood and sediment damage from natural or human-induced causes.
- Reducing salt loading in watersheds that lie within the Colorado River Basin.
- Meeting or exceeding established standards for quality of surface water and groundwater where water quality has been lowered by human-induced causes.
- Providing for physical and legal availability of water for use by the public and federal, state, and local agencies for fisheries and wildlife and for livestock, recreational, municipal, and industrial uses.
- Implementing intensive practices to mitigate salt and sediment loading.
- Addressing site-specific problems with activity plans including monitoring for salt and sediment loading.
- Administering watershed management practices designed to meet water resource management objectives

The following criteria were used to determine significant impacts to water resources:

- non-compliance with management objectives and actions listed above from the RMP (USDI-BLM 1990a);
- degradation of water quality such that state standards outlined in the Rules and Regulations of the Water Quality Division of the Wyoming Department of Environmental Quality are not met;
- degradation of groundwater quality in aquifers that are directly used as a groundwater source by wells or that discharge into water bodies used for irrigation, domestic purposes, and wildlife and fisheries;
- alteration of channel geometry or gradients that produce undesirable effects such as aggradation, degradation, or side-cutting;

- modification of the quantity and quality of streamflows such that it affects established users; and

- non-compliance with the Federal Clean Water Act.

4.4.3 Direct and Indirect Impacts

4.4.3.1 Proposed Action

Due to exposure and compaction of the soil surface during project construction, infiltration capacities would decrease, and surface runoff, erosion, and off-site sedimentation would increase. (See Soils Section 3.3 for a description of the acres impacted.) This could increase water yield and stream flow and degrade water quality. These impacts would be most severe during the construction phase while soils are in a disturbed state. These impacts would substantially decrease in magnitude during the production primarily due to successful reclamation and control measures.

The increase in quantity of streamflow would be negligible and undetectable due to the relatively small area affected (approximately 2,010 acres total) at any given time and the high degree of surface runoff variability experienced by the ephemeral and intermittent streams of the GWA II analysis area. All facility sites (wells, processing plants, etc.) except for pipelines and roads would be located a minimum of 500 feet from surface water features per RMP directives. The vast majority of these facilities would be located well away from stream channels. Effective surface runoff, erosion, and sedimentation control measures would be implemented at drill sites, production well sites, and production facilities as described in Chapter 2. Therefore, a significant increase in surface runoff and sediment transport from these disturbed sites would not occur.

Pipelines and roads, being linear facilities, would traverse ephemeral and intermittent stream channels on limited occasions where avoidance of such crossings would not be feasible. The vast majority of such crossings would involve ephemeral channels and vegetated swales. Road crossings would be constructed with sufficiently sized corrugated metal pipe (CMP) culverts to competently handle design storm runoff events per BLM road guidelines. Similarly, the crossings would minimize modifications of channel morphology and gradient so as to avoid channel degradation and/or aggradation. Providing for adequate culvert or other channel crossing structure capacities and periodic inspection for structure competence and effectiveness would be particularly important to avoid important impacts on the intermittent streams identified in Table 3-9. Therefore, no significant impacts would likely occur in regard to surface water quantity due to construction of roads and pipelines across drainage channels.

Some of the drainage channels identified previously are classified as waters of the U.S. and/or jurisdictional wetlands. Crossings of these channels would require authorization from the Corps of Engineers (COE) through the Section 404 permitting process. However, these channel crossings would likely receive expedited authorization from the COE through Nationwide Permit

No. 12 (buried utility lines) and/or No. 14 (minor road crossing fills). Each individual channel crossing would be reviewed during the APD/ROW permitting process for potential adverse impacts on water resources.

As discussed in the Soils Section (4.3), approximately 17,243 t/yr of soil erosion could occur from soil disturbances in the first year without erosion control or 6,649 t/yr with erosion control. These estimates are for total soil detached and entrained in place and do not include sediment transport over the ground surface. The vast majority of the soil detached and entrained is transported and deposited in very close proximity to the source and very little sediment is transported successfully to stream channels (over 500 feet per RMP directives). The primary factors of sediment delivery efficiency include slope gradient, roughness of soil and vegetation, and overland distance of transport. Most drainage channels occur in valley bottom locations with sideslope gradients less than 10 percent. Undisturbed vegetation is relatively dense ranging from 50 to 80 percent. As indicated, the vast majority of soil disturbance is well away from stream channels. Given these conditions, sediment delivery efficiency is likely to be well below 10 percent. Using this efficiency (i.e., 10 percent), approximately 1,724 t/yr without erosion control and 665 t/yr with erosion control would be transported to stream channels in the first year. In regard to an increase in sediment delivery, these sediment delivery values would equate to an increase in sediment yield in streams of approximately 0.001 ac-ft/mi^2/yr as compared to the BLM's estimate of current sediment yield of 0.28 ac-ft/mi^2/yr. As discussed in Chapter 3, most of the yield originates from channel erosion and degradation due to infrequent high intensity thunderstorm events.

For the same reasons described above, minimal leaching of salts from disturbed saline soils and subsequent minimal translocation of salt loading to streams would occur as a result of the proposed project. This is due to the small quantities of sediment that are transported to streams and the minimal increase in surface runoff combined with the distant location of most of the project facilities from stream channels. Increased salt loading, however small, would be minimal compared to the salts that naturally accumulate through evaporation in the ephemeral and intermittent channels. Therefore, no significant increase in salt loading is expected within the GWA II analysis area, nor further downstream in Muddy Creek, Little Snake River and below within the Colorado River basin.

The above analysis is for general sediment loading from overall soil disturbance. There is a chance that certain surface runoff, erosion, and sediment control measures could be ineffectively applied or ineffective in regard to function for a variety of reasons. Such undefined areas could provide a large increase in sediment loading at a point source, but overall would have a negligible affect on overall sediment yield increase. Thus, significant increases in sediment delivery to streams and the sediment yield of streams in the project area are not likely to occur with project implementation.

Water would be required during the construction phase for road and drill-site construction, well drilling, well completion, and hydrostatic testing of pipelines. The source, amount, and/or timing of water use has not been specifically identified by the Operators. Approximate water usage for project construction could be as high as 1,000 gallons per acre of disturbance. This would equate to approximately 7.0 ac-ft of water. Water would also be used for hydrostatic testing of pipelines. Most of the pipelines would be four inches in diameter. As indicated in Chapter 2, approximately 0.5 miles of new pipeline would be required for each well pad (including multiple wells from one pad). Assuming all pipelines would be tested at once and therefore water would not be re-used, approximately 1.6 ac-ft of water would be required. Well drilling would require approximately 420,000 gallons or 1.3 ac-ft of water per well for a total of 975 ac-ft for all proposed drilling. Well completion and testing would require approximately 105,000 gallons per well or 0.3 ac-ft per well for a total of 225 ac-ft of water. Therefore, the total maximum water usage required for the project during all phases (i.e., construction, testing, and production) would be approximately 1,209 ac-ft.

Handling and management of hydrostatic test water would need to be accomplished in a manner that does not adversely affect soils, streams channels, and surface water and groundwater quality. Used water from hydrostatic testing has relatively good water quality. A large portion of the hydrostatic test water would be re-used for other aspects of the construction, drilling, completion, and/or production processes. However, if such water is not re-used it must be disposed of in a manner where soil scouring and water quality impairment would not result.

As discussed in Chapter 2, water conservation and the re-use of water would be practiced by the Operators where feasible. Therefore, the actual quantity of water used by the Proposed Action would be considerably less than 1,300 ac-ft. Water for use in project construction would be obtained from several potential sources including: 1) existing water wells within the GWA II analysis area, 2) recently drilled water wells in the Echo Springs Field, and 3) from water wells drilled on the well pads. All water used for project construction would be obtained from State of Wyoming approved water sources. The depth of most of these wells that could serve as a source of water ranges from 1,500 feet to over 8,000 feet. Most domestic and/or livestock wells have been completed at shallower depths, from 150 to 750 feet deep. Therefore, most extraction of groundwater for project construction would utilize different depths of groundwater and would not adversely affect domestic and livestock wells.

Reserve pits would be utilized to contain drilling cuttings and waste water from the well drilling operations. As indicated in Chapter 2, reserve pits would be both lined and unlined depending on character of earth material the pits are constructed in and distance to sensitive environments. In general, pits would be lined in areas that have a shallow water table; groundwater recharge areas; areas within the Washakie Basin that drain into the Little Snake, Yampa, and Colorado rivers; drill sites within 500 feet of stream channels, seeps, springs, and/or internally drained lakes; and/or where reserve pits are constructed in earthen fill (as opposed to cut). BLM policy rarely allows reserve pits to be constructed in fill. Impermeable membrane material between 12 to 16 mils thick would be used to line a reserved pit. Leakage of pit fluids would be minimal from lined reserve pits unless the liners were installed incorrectly or the liners were damaged during drilling operations. Thus, adverse impacts from leaks in lined reserve pits would likely not occur.

Unlined pits would be used where fresh water based mud systems are used during drilling. Where used, unlined pits would be constructed in cut areas of a drill pad. Due to soil permeability problems, even lined pits, with perhaps rare exception, would be constructed only in cut areas also (as opposed to fill per BLM policy). The specific character of the cut material and its suitability for siting a reserve pit would be assessed prior to pit construction. Such material would be relatively tight with low infiltration and permeability rates. The potential for adverse impacts on surface water and groundwater quality would be greater for unlined pits as compared to lined pits. However, significant impacts on water quality resulting from leakage from unlined pits would be unlikely given the restrictions regarding when or where such pits would be used.

Well drilling and completion may adversely affect groundwater quality if mixing of water from different aquifers occurs. Deeper groundwater usually occurs under confined conditions. If a confined aquifer is penetrated, vertical (up or down) migration of groundwater may occur resulting in mixing of water of differing qualities. This mixing may result in a reduction in water quality. The magnitude of mixing is relatively small during drilling due to the relatively short period of time drilling is accomplished. In general, the upper 1,500 feet of the well is cased and cemented during the drilling process and this zone remains cased and cemented during the production phase. Therefore, the opportunity for significant degradation of groundwater quality in the upper aquifers is low.

Well completion must be accomplished in compliance with "On-shore Oil and Gas Order No. 2." These guidelines specify the following:

> ". . . proposed casing and cementing programs shall be conducted as approved to protect and/or isolate all usable water zones, potentially productive zones, lost circulation zones, abnormally pressured zones, and any prospectively valuable deposits of minerals. Any isolating medium other than cement shall receive approval prior to use" (USDI-BLM 1989).

Usable water is defined as groundwater with a TDS of 10,000 ppm or less encountered at any depth. To comply with the order, wells must be completed in a manner by which either usable water is isolated from "unusable" water, or such that unusable water is isolated from usable water through the use of cementing and other proven technologies. Depending on the location of each well, most of the aquifers below 1,500 feet contain groundwater in excess of 10,000 TDS; however, some aquifer units contain usable water below 1,500 feet (see Water Resources Section 3.4 of Chapter 3). Therefore, cementing below 1,500 feet may be necessary to comply with the order. With well completion in compliance with the order, no significant impacts on groundwater quality would occur due to project implementation.

Corrosion of well casing has recently been identified as a problem resulting in mixing groundwater of various quality. Cathodic corrosion inhibitors are being utilized by several operators to reduce such corrosion and subsequent leakage and mixing of groundwater. Similar protection devices or measures would be applied in this proposed project to protect groundwater quality and the integrity of the producing well.

4.4.3.2 Alternative A

Potential impacts described under the Proposed Action also apply to Alternative A as well. The Soils Section (4.3) describes the acres of impacts expected. The potential for such impacts under this alternative is likewise low, given stipulations and management actions incorporated into the proposal (Chapter 2).

Under this alternative, water use would be less than the Proposed Action. Water would be required during the construction phase for road and drill site construction, well drilling, well completion, and hydrostatic testing of pipelines. Proposed water use for road and drill site construction has not been identified by the Operators at this time. However, approximate water usage could be as high as 1,000 gallons per acre of disturbance. This would equate to approximately 6.0 ac-ft of water. Water would also be used for hydrostatic testing of pipelines, most of which would be four inches in diameter. As indicated in Chapter 2, approximately 0.5 miles of new pipeline would be required for each well pad (including multiple wells from one pad). Assuming all pipelines would be tested at once, and that water would not be re-used, approximately 1.3 ac-ft of water would be required. Well drilling would require approximately 420,000 gallons or 1.3 ac-ft of water per well for a total of 390 ac-ft for all proposed drilling. Well completion and testing would require approximately 105,000 gallons per well or 0.3 ac-ft per well for a total of 90 ac-ft of water. Therefore, the total maximum water usage required for this alternative would be approximately 487 ac-ft. Based on these water requirements and the impact discussion presented under the Proposed Action, no significant impacts to water resources under this alternative are expected.

4.4.3.3 Alternative B

Potential impacts described under the Proposed Action also apply to Alternative B as well. The Soils Section (4.3) describes the acres of impacts expected. The potential for such impacts under this alternative is likewise low, given stipulations and management actions incorporated into the proposal (Chapter 2).

Under this alternative, water use would be less than the Proposed Action. Water would be required during the construction phase for road and drill site construction, well drilling, well completion, and hydrostatic testing of pipelines. Proposed water use for road and drill site construction has not been identified by the Operators at this time. However, approximate water usage could be as high as 1,000 gallons per acre of disturbance. This would equate to approximately 5.0 ac-ft of water. Water would also be used for hydrostatic testing of pipelines, most of which would be four inches in diameter. As indicated in Chapter 2, approximately 0.5 miles of new pipeline would be required for each well pad (including multiple wells from one pad). Assuming all pipelines would be tested at once, and that water would not be re-used, approximately 1.0 ac-ft of water would be required. Well drilling would require approximately 420,000 gallons or 1.3 ac-ft of water per well for a total of 293 ac-ft for all proposed drilling. Well completion and testing would require approximately 105,000 gallons per well or 0.3 ac-ft per well for a total of 68 ac-ft of water. Therefore, the total maximum water usage required for this alternative would be approximately 367 ac-ft. Based on these water requirements and the impact discussion presented under the Proposed Action, no significant impacts to water resources under this alternative are expected.

4.4.3.4 Alternative C - No Action

Under this alternative, water resources within the GWA II analysis area would remain as described in Chapter 3, Affected Environment. Development in the GWA II analysis area not associated with this project would continue. Therefore, water resources in the GWA II analysis area would continue to be affected by other development and land management.

4.4.4 Impacts Summary

Potential impacts that could occur due to project implementation include increased surface water runoff and off-site sedimentation due to soil disturbance; increased salt loading and water quality impairment of surface waters; changes in stream discharge due to project disturbance; changes in groundwater levels, quantity, and quality; and channel morphology changes due to road and pipeline crossings. Under the Proposed Action, the alternative with the greatest magnitude of development activity, no significant impacts on surface water or groundwater quality and quantity would occur. The magnitude of non-significant adverse impacts as compared to the Proposed Action would decrease under Alternative A, Alternative B, and the No Action alternative, Alternative C. Implementation of the Proposed Action alternative would require approximately 1,209 ac-ft of water during the construction, completion, and production phases, while Alternative A would require 487 ac-ft, and Alternative B would require 367 ac-ft.

4.4.5 Cumulative Impacts

Cumulative impacts include water resource impacts from ongoing activities, recently constructed projects, and projects likely to be implemented in the near future. Cumulative impacts can be divided into two geographic areas including those within the GWA II analysis area and those occurring outside the GWA II analysis area as described in Section 4.3.5. A detailed analysis of existing disturbance within the GWA II analysis area and the cumulative impacts analysis (CIA) area is presented in the Soils and Water Resources Technical Report (ECOTONE 1995c).

GWA II Analysis Area. Existing disturbance within the GWA II analysis area was identified, delineated, and mapped using aerial photographs taken in May of 1994 as described in detail in the Soils and Water Resources Technical Report. Existing disturbance within the GWA II analysis area, as discussed in Section 2.7.2., is approximately 12,527 acres, or around 3.7 percent of the 334,191 acres comprising GWA II analysis area. During the construction phase, the Proposed Action would add 2,416 acres of impact for a cumulative area of 14,943 acres (4.5 percent). This cumulative disturbance would not significantly impact surface water and groundwater quantity and quality for the reasons discussed under Section 4.4.3.1.

Cumulative Impacts Area. The geographic area outside the GWA II analysis area considered in the cumulative impacts analysis (CIA) was defined following USDI-BLM (1994a) guidelines based on the USGS delineated watershed boundaries that the GWA II analysis area covered or touched, an area approximately 780,440 acres in size. Existing disturbance in the CIA area was estimated as described in Section 4.4.4.2. A portion of the Creston/Blue Gap field development project falls within the CIA area of the GWA II analysis area. The existing disturbance and future disturbance due to the Creston/Blue Gap project has been included in the following analysis. No other permitted projects within the CIA area are evident at this time. The Mulligan Draw, Carbon County UCG Program, and Patrick Draw projects are located outside the CIA area.

The total existing disturbance in the total CIA area (including GWA II analysis area) was estimated to be approximately 21,333 acres, or 1.9 percent of the combined CIA and GWA II areas. Impacts due to the Proposed Action would be approximately 2,416 acres. This combined with the existing disturbance in the CIA and GWA II areas would be approximately 23,749 acres or 2.1 percent of the combined area of 1,114,630 acres. This cumulative disturbance would not significantly impact surface water and groundwater quantity and quality for the reasons discussed under Section 4.4.3.1.

No serious groundwater pollution problems have been detected in the CIA area. Current oil and gas exploration and development activities must comply with federal and state environmental quality laws and thus, serious water quality and quantity impacts are not expected on a cumulative scale. Section 3.4.3.3 identified current water usage in the general area of the GWA II project to be approximately 90,000 ac-ft per year for all combined surface water and groundwater sources and uses (Collentine et al. 1981). This estimate likely includes uses outside the CIA area. Using this estimate as an environmentally conservative indication of total existing water usage, the GWA II project (1,209 ac-ft total) and the Creston/Blue Gap project (2,695 ac-ft), and Mulligan Draw Field development project (254 ac-ft) total water usage within the CIA area could be as high as 95,000 ac-ft. Although this is a relatively large quantity of water, it is a relatively minor portion of total surface water and groundwater yield/availability. Therefore, cumulative impacts on surface water and groundwater quantity would not be significant.

4.4.6 Mitigation Summary

No additional measures beyond stipulations presented in Chapter 2, management direction contained in the RMP, Appendix B, and addition mitigation strategies identified in the above analysis would be required to minimize adverse impacts to water resources to non-significant levels.

4.4.7 Residual Impacts

With full and successful implementation of measures outlined in Chapter 2, Section 4.4.2, the above analysis, and Appendix B, no significant residual impacts would occur.

4.5 VEGETATION AND WETLANDS

4.5.1 Introduction

Direct impacts would include the short-term loss of vegetation (modification of structure, species composition, and areal extent of cover types). Indirect impacts would include the short-term and long-term increased potential for weed invasion, establishment, and expansion; exposure of soils to accelerated erosion; shifts in species composition and/or changes in vegetative density; reduction of wildlife habitat; and changes in visual aesthetics.

4.5.2 Impact Significance Criteria

The Great Divide RMP (USDI-BLM 1990a) prescribes the following objectives and actions relative to vegetation and wetlands:

- Using prescribed fire to meet objectives of other programs/improve habitat.

- Enhancing the health, productivity, and diversity of forest land (for this EIS, this objective is assumed to also apply to rangeland as well).

- Maintaining or enhancing populations of plant species of concern. Protecting known populations of plant species of concern, avoiding damage by temporally and spatially managing projects, and using case-by-case examination of proposed surface disturbance activity to determine potential impacts and mitigation.

- Maintaining riparian areas in good or excellent condition or improve areas that are in poor or fair condition.

- Prohibiting surface disturbance within 500 feet of surface water and/or riparian areas.

- Maintaining or improving vegetation condition and/or avoid long-term disturbance in high priority standard habitat sites and fisheries areas.

The following criteria were used to determine the significance of construction and operation of the proposed project on vegetation resources within the GWA II analysis area. These criteria were developed based on management directives, professional judgement, involvement in other NEPA projects throughout the West, and state regulations (e.g., the Wyoming Noxious Weed Act).

- non-compliance with management directives for the Great Divide Resource Area;

- removal of vegetation such that following reclamation, the disturbed area(s) would not have adequate cover (density) and species composition (diversity) to support pre-existing land uses, including wildlife habitat, within a period of five years for general vegetation types or within two years for riparian and wetland areas;

- unauthorized discharge of dredged and/or fill materials into or excavation of waters of the U.S., including special aquatic sites, wetlands, and other areas subject to the federal Clean Water Act, Executive Order 11988 (floodplains) and Executive Order 11990 (wetlands and riparian zones);

- introduction and establishment of noxious or other undesirable weedy plants species to the degree that more than 20 percent of a disturbance area resulting from the proposed project is occupied by such species thereby adversely affecting successful reclamation;

- removal or disturbance of plant species of concern (including special status species) and/or habitat judged important for survival to the extent that such impact would threaten the viability of the local population and/or induce an upgrade in the federal, state, or resource area status;

- cumulative removal of more than 10 percent of any vegetation cover type within the project-specific GWA II area and/or more than three percent within the cumulative impact area (i.e., watershed of the GWA II analysis area).

4.5.3 Direct and Indirect Impacts

4.5.3.1 Proposed Action

Vegetation removal and soil handling associated with the construction and installation of well pads, pipelines, access roads, and other facilities as outlined in Chapter 2 would affect vegetation resources both directly and indirectly. Direct impacts would include the short-term loss of vegetation (modification of structure, species composition, and areal extent of cover types). Indirect impacts would include the short-term and long-term increased potential for weed invasion, establishment, and expansion; exposure of soils to accelerated erosion; shifts in species composition and/or changes in vegetative density; reduction of wildlife habitat; and changes in visual aesthetics.

Construction of the Proposed Action would affect 2,416 acres (1,500 acres for well locations and associated facilities, seven acres for the compressor station and 909 acres for combined pipeline/access road ROWs). Assuming all locations are productive, this area of impact would be reduced (upon successful reclamation) to 1,364 acres (630 acres for well locations, seven acres for the compressor station, and 727 acres for road/pipeline, assuming 10 feet of the 50-foot ROW would be reclaimed). The likelihood of impact is greatest for the mixed desert shrub cover type, which occupies 76 percent of the GWA II analysis area. Except for habitats occupied by plant species of concern, clearing of upland cover types would not be significant because upland cover types are generally abundant and widely distributed throughout the region and/or have been previously impacted (e.g., urban land, disturbed land).

Construction activities, increased soil disturbance, and higher traffic volumes could spur the introduction and spread of undesirable and noxious weed species within the GWA II analysis area. Weed invasion and establishment has become an increasingly important result of previous disturbance (i.e., 12,527 acres) in the GWA II analysis area. Weeds often out-compete desirable species, including species of concern, rendering an area less productive as a source of forage for livestock and wildlife. Additionally, sites dominated by weeds often have a different visual character that may negatively contrast with surrounding undisturbed vegetation. However, with implementation of best management practices and proposed mitigation measures (including Measure 4 in Section 2.3.4.1 and Measures 2 and 3 in Section 2.3.4.2.5), no significant impacts are anticipated.

Fugitive dust generated during project construction and operation could adversely affect vegetation including plant species of concern due to deposition on leaves. Although deposition of dust on leaves could have an adverse effect, the magnitude of this impact would likely be minimal. Fugitive dust control has been adopted by the BLM and operators, and therefore such an impact would be minimal.

Potential impacts to waters of the U.S., including wetlands and other special aquatic sites, could include clearing, excavating, filling, and grading. Such impacts would reduce the area and functional values offered by an affected cover type. Specific project impacts on waters of the U.S. cannot be accurately assessed since facility locations have not been identified. However, waters of the U.S. comprise less than 1.5 percent of the GWA II analysis area and their occurrence is not contiguous. Given this, well sites would be located to avoid wetlands. Road and pipeline facilities, however, might affect a small amount (estimated < 5 acres) of wetlands where such facilities cannot be located to avoid wetlands. Given implementation of Measure 11 in Section 2.3.4.2.3, Measure 4 in Section 2.3.4.2.4, and Measure 4 in Section 2.3.4.2.5 as well as compliance with the RMP, the CWA, and Executive Orders 11990 and 11989, the probability of significantly impacting waters of the U.S. is low. As such, no significant impacts are anticipated. Road and pipeline crossings would likely be authorized under COE Nationwide Permits 12 (pipelines) or 14 (roads). Compliance might involve compensatory mitigation for affected wetlands if such areas cannot be avoided. This topic is further addressed in the Mitigation discussion.

Management directions emphasize the need to protect plant species of concern. Surface disturbing activities could affect plant species of concern directly and indirectly by destroying individuals or their habitat, increasing the amount of fugitive dust, and introducing weeds. As plant species of concern in desert areas often exploit unique and/or harsh environments (e.g., cliffs, rocky talus slopes, and barren or semi-barren windswept ridges and slopes), Delaney Rim and areas supporting the barren/cushion plant cover type have the highest potential for the occurrence of plant species of concern and/or habitat, although sandy areas, playas, and mixed desert shrub have variable potential. Barren/cushion plant areas comprise 19 percent of the GWA II analysis area; potential habitat areas other than mixed desert shrub comprise around one percent of the GWA II analysis area. With implementation of Measure 5 in Section 2.3.4.2.5, mitigation recommended in Section 4.5.5, and compliance with RMP management directives, no significant impacts to plant species of concern are anticipated under the Proposed Action.

4.5.3.2 Alternative A

Fewer acres of construction impacts (1,250 acres for well locations, seven acres for the compressor station, and 758 acres for road/pipeline ROW, for a total of 2,015 acres) would occur to all cover types, including wetlands and other special aquatic sites, under Alternative A. Production phase impacts would be 525 acres for well locations, seven acres for the compressor station, and 606 acres for road/pipeline ROW, for a total of 1,131 acres. As with the Proposed Action, the amount and duration of such impacts would depend on the locations of the wells and access roads. However, the majority of this impact would occur in the mixed desert shrub and barren/cushion plant cover types. Direct and indirect impacts to waters of the U.S. and to plant species of concern and their habitat are not specifically for the well site locations. However, impacts would likely be lower than for the Proposed Action given the lesser area of land that would be affected. The stipulations prescribed in the RMP (USDI-BLM 1990a) and measures committed to by the Operators (Chapter 2) would preclude significant impacts to vegetative resources for reasons identified previously.

4.5.3.3 Alternative B

Alternative B would affect 1,000 acres for well locations, seven acres for the compressor station, and an additional 606 acres for road/pipeline ROWs, for a total impact of 1,613 acres during project construction. With reclamation, production phase impacts would be reduced to 420 acres for well locations, seven acres for the compressor station, and 484 acres for road/pipeline ROWs for a total of 911 acres. Again, the majority of this impact would occur in upland cover types, most specifically in areas of mixed desert shrub and barren/cushion plant. Fewer waters of the U.S. would be affected under this alternative than under the Proposed Action or Alternative A. The exact amount would depend on the locations of the road/pipeline ROWs. Direct and indirect impacts to plant species of concern and their habitat are unknown for the well locations. However, given the stipulations prescribed in the RMP (USDI-BLM 1990a) and measures committed to by the Operators (Chapter 2), no significant impacts are expected to vegetative resources under this alternative.

4.5.3.4 Alternative C - No Action

Under the No Action Alternative, vegetation would continue to be impacted as APDs are granted by the BLM. Loss of upland cover types would not be significant. If present, impacts to wetlands would be assessed and mitigated on a case-by-case basis similar to the Proposed Action and action alternatives. Rare plant surveys would continue to be performed prior to earth-surface disturbance activities associated with individual projects. Noxious weed programs would be implemented per stipulations in individual APDs.

4.5.4 Impacts Summary

Implementation of the Proposed Action and action alternatives (A and B) would initially affect 2,416 acres, 2,015 acres, and 1,613 acres of various vegetation cover types, respectively, during project construction. Reclamation efforts during well production would reduce respective impacts to 1,364 acres, 1,131 acres, and 911 acres, respectively.

Impacts to vegetation would include removal of cover types (potential to decrease diversity and density of desirable species) and the increased potential for noxious weed invasion and establishment. Associated effects of such loss on wildlife, visual resources, and land use are discussed under those headings. Except for waters of the U.S. (including wetlands and other special aquatic sites) and/or plant species of concern and their habitat, a reduction in vegetation density would not be significant because upland vegetation types are relatively common, cover large areas, have wide distribution, and occur with high frequency within the project area as well as on other lands within the Great Divide and Washakie basins. (See cumulative impacts for a discussion on the impact to vegetation cover types relative to existing disturbance in the GWA II analysis area and to projects within this larger context area.)

Monitoring for invasion and establishment of weeds and prompt and aggressive remediation, as provided for in Chapter 2, would prevent further weed invasion/establishment problems and facilitate successful revegetation of disturbed areas.

Project implementation could potentially impact the area and functions of wetlands, special aquatic sites, and other waters of the U.S. Direct impacts could occur through filling, grading, and excavation; indirect impacts could occur through hydrologic modification, sedimentation, pollution, and disturbance. Due to the larger area of disturbance associated with road/pipeline ROW facilities, the Proposed Action would be more likely to affect waters of the U.S. than the other alternatives. However, measures imposed by the RMP (USDI-BLM 1990a) and 404 permitting process would prevent or avoid impacts to jurisdictional wetlands and other special aquatic sites. Further, compliance with Section 404(b)(1) guidelines would remove the potential for significant impacts under all alternatives.

All alternatives have potential to affect plant species of concern or habitat for such species. However, given implementation of Chapter 2 measures and mitigation as outlined in this section, no significant impacts are anticipated.

The duration and magnitude of impacts to vegetation cover types would depend on the locations of well sites and access roads, the success of mitigation and revegetation efforts, and the time needed for natural succession to return revegetated areas to predisturbance conditions. The latter may be on the order of 20 to 30 years for the mixed desert shrub community type. Revegetation success would depend on the amount and quality of topsoil salvaged, stockpiled, and respread over disturbed areas as well as weed control efforts.

Reclamation would be accomplished according to a site-specific reclamation and revegetation plan that uses best-management practices. Revegetation would involve the use of plant materials that meet specific reclamation objectives in terms of soil erosion control; soil protection, stabilization, and fertilization; aesthetics; and compatibility with native vegetation adjacent to the disturbance area. In spite of the poor reclamation potential for many soils (see discussion under Soils, Section 3.5 of Chapter 3), technology exists to return disturbed areas to predisturbance conditions in the time frame indicated by the significance criteria.

4.5.5 Cumulative Impacts

The GWA II analysis area comprises approximately one third of the larger Cumulative Impact Area (CIA), which is defined by the watershed of the GWA II analysis area (see Section 4.3.5). Existing disturbance within the GWA II analysis area, as discussed in Section 2.7.2, is 12,527 acres, or around 3.7 percent of 334,191 acres. During the construction phase, the Proposed Action would add 2,416 acres of impact for a cumulative area of 14,943 acres (4.5 percent). Alternative A would increase existing disturbance by 2,015 acres to 14,542 acres (4.4 percent). Alternative B would produce 1,613 acres of new impact for a total of 14,140 acres (4.2 percent). Under Alternative C, additional surface disturbance would occur on a case-by-case basis. It is anticipated that such impact would be between 3.7 and 4.5 percent of the GWA II analysis area.

Impacts within the GWA II analysis area would be reduced upon reclamation of pipeline ROWs and unused portions of the drill pads during the production phase for each alternative. Under the Proposed Action, reclamation would reduce impacts by 1,052 acres for a cumulative impact of 4.1 percent of the GWA II analysis area. Alternative A impacts would decrease by 884 acres, with cumulative impacts affecting 4.0 percent of the GWA II analysis area. Alternative B impacts would drop by 616 acres; therefore, cumulative impacts would drop to 4.0 percent of the GWA II analysis area. Impacts under Alternative C would decrease by approximately 2.9 acres per well site and roughly 80 percent of the area associated with road/pipeline ROWs. The cumulative effect, however, is anticipated to be between 3.7 and 4.3 percent of the GWA II analysis area.

Colorado Interstate Gas's Uinta Basin Lateral pipeline project occurs in the GWA II field area, as does the Echo Springs Gas Gathering System; therefore, impacts associated with those projects have been included in the existing disturbance of the GWA II analysis area rather than in the following section.

The loss of vegetation within the GWA II analysis area would not be cumulatively significant based on the criteria presented. The exceptions to this statement would be the loss of water of the U.S. and plant species of concern or habitat.

Any unpermitted impact to waters of the U.S. associated with this project or other projects in the vicinity or region would add to the cumulative loss of these important areas. The historical loss of wetlands in the U.S. has been well documented as a major environmental problem. The total area of wetlands loss in the U.S. (lower 48 states) is not accurately known but is believed to exceed 90,000,000 acres--nearly half the estimated original base. Of this total, 87 percent was due to agricultural conversion, eight percent due to urban development, and five percent due to other causes including mining and transportation (Dahl and Pywell 1989). Within Wyoming, there has been an approximate 38 percent loss of wetlands. A COE-approved Section 404 permit with requirements of avoidance of waters of the U.S., including special aquatic sites and wetlands, and measures prescribed in Chapter 2 would remove the potential for significant cumulative impacts to these sensitive areas. Likewise, no significant cumulative impacts would occur to plant species of concern or their habitat within the GWA II analysis area upon implementation of the proposed and recommended mitigation measures.

4.5.6 Mitigation Summary

Mitigation measures committed to by the Operators (Chapter 2) include site-specific recommendations being developed by an IDT for staked facilities; preparation of surface use plans; minimization of impacts due to clearing and soil handling; implementation of adequate erosion control measures; reseeding and site rehabilitation; noxious weed monitoring and control/eradication per BLM policy; compliance with Section 404(b)(1) guidelines of the federal CWA; and clearance surveys for plant species of concern.

By way of clarification, weed monitoring should occur for species identified by the State of Wyoming as well as for additional species specified by each county during a given year. Such species comprise the official list of weeds for which a county can cost-share funding for control and removal efforts.

On-the-ground clearance surveys should be performed for plant species of concern identified by the WYNDD, U.S. Fish and Wildlife Service (FWS), and BLM. Such species include those listed as threatened or endangered, those proposed for listing and those that are candidate Category 1 and 2 species for federal listing. As species may be added or deleted to the list identified in this EIS, these organizations should be contacted for the most current list of species prior to performing surveys.

Although not specifically stated in the RMP, surface disturbance should be prohibited within 500 feet of jurisdictional wetland areas--not only surface waters and/or riparian areas--and wetlands should be maintained in good or excellent condition or improved in areas that are in fair to poor condition.

No further measures beyond compliance with the RMP (USDI-BLM 1990a), the mitigation measures in Chapter 2, the BLM's Wyoming Policy on Reclamation (USDI-BLM 1990b), and Chapter 4 measures recommended for Vegetation and Wetlands, Soils, Water Resources, and Visual Resources would be required to prevent significant impacts.

4.5.7 Residual Impacts

No significant unavoidable adverse residual impacts to vegetation resources would occur with implementation of mitigation stipulations in the RMP and measures proposed by UPRC although successful revegetation within three to five years would be difficult for some cover types. Revegetation to "predisturbance" conditions would require 30 years or more; however, this lag would not be significant provided substantial erosion or other significant environmental impacts do not occur during this long-term period.

Construction of the proposed project would involve clearing vegetation within the GWA II analysis area. Such loss of vegetation would be irretrievable. The loss could be partially reversible through revegetation of cut-and-fill slopes; however, some areas (e.g., destabilized sand dunes) may be particularly difficult to reclaim and could constitute an irreversible commitment of resources even with best management practices. Loss of species of concern or their habitat would also be an irreversible and irretrievable commitment of resources.

Potential impacts to waters of the U.S., including wetlands and other special aquatic sites, would be both reversible and retrievable through avoidance, impact minimization, and comprehensive compensatory mitigation that would ensure replacement of lost area and functional values of these sensitive cover types. If wetlands are impacted, the implementation of compensatory mitigation prior to project construction would reduce the potential for irretrievable impacts.

4.6 RANGE RESOURCES AND OTHER LAND USES

4.6.1 Introduction

Livestock grazing would continue within the GWA II analysis area during all phases of the natural gas development project. There would be some reduction in forage availability in those areas having natural gas development activities (e.g., well pad, access road, and pipeline construction).

4.6.2 Impact Significance Criteria

Impacts to the land resource would be significant if the following occurred:

- Non-compliance with management objectives outlined in Chapter 2 and the Resource Management Plan (RMP) (USDI-BLM 1990a).

4.6.3 Direct and Indirect Impacts

4.6.3.1 Proposed Action

As discussed in Chapter 2, each constructed drill site would remove approximately five acres from forage production with implementation of the Proposed Action. This loss coupled with new roads and pipelines, would result in an estimated loss of 2,416 acres of forage production during the initial stages of the project. Stocking rates are estimated to vary between seven and 26 acres per animal unit month (AUM) between the various allotments within the GWA II analysis area, with an average stocking rate of about nine acres per AUM. Depending on the actual locations of the well sites with respect to forage productivity, lost forage would vary between 93 and 345 AUMs, with an average of 219 AUMs, or a reduction of about 1.1 percent of the current livestock forage use in the GWA II analysis area.

The Proposed Action (750 wells at 300 locations) is of a magnitude to possibly create adverse affects on some livestock operators, depending on well site, access road, and pipeline placement. Possible impacts would include loss of forage and disruption of livestock management practices, primarily herding. Most of these impacts would be short-term, lasting only as long as construction activities were ongoing. Once production operations are underway and reclamation measures completed, impacts to livestock operations would be minimal.

Long-term loss of forage for livestock use would be less than short-term loss. Production well sites are about 2.1 acres in size. Partial reclamation of well sites would place about 471 acres or 52 AUMs back into forage production. There would also be additional forage production on the revegetated pipeline corridors and unused portions of the access roads. In addition, as existing, older production wells in the GWA II analysis area are abandoned and reclaimed, additional land would become available for forage production. Actual amounts of additional forage available for livestock use following reclamation would be contingent on the success/failure of revegetation efforts.

The increased activity associated with drilling and production has the potential for disrupting livestock operations, particularly during the construction phase of development. Opportunities for vehicle-livestock collisions would increase. Also, though the increase of roads would offer additional access into the allotments, potentially providing livestock operators with greater ease of livestock management operations such as herding, etc., the opportunity for livestock theft would also increase. The potential for problems would decrease once the wells were producing and the traffic volume reduced. Also, drilling may result in the development of additional water wells which could be converted to livestock use. This would improve the ability of livestock to make efficient use of rangeland within the area, especially during dry years.

Construction activities could provide for introduction of undesirable and noxious weed species into the project area. These undesirable annuals often out-compete the more desirable species, rendering an area less productive as a source of forage for livestock and wildlife.

Given the actions and measures proposed by UPRC and other operators and stipulations contained in the RMP (USDI-BLM 1990a), no significant impacts would occur to the range resources under this alternative.

4.6.3.2 Alternative A

The area removed from forage production under Alternative A is estimated to be 2,015 acres, with a resultant loss of 223 AUMs. This represents a loss in stocking levels of about 0.6 percent throughout the GWA II analysis area. Once the well sites, pipeline corridors, and access road ROW's have been properly revegetated, about 23 AUMs would be brought back into production, resulting in a long-term forage loss of about 200 AUMs (approximately 0.5 percent of the GWA

II analysis area, unless the well sites are located predominately on a select few permittees and/or are located on areas where forage production is greater than the average of the GWA II project area.

The potential for livestock theft, and loss from vehicular collision, and the potential for introduction of weed species also exists as discussed in the Proposed Action, but to a lesser degree. Also, the potential for enhancing livestock operations (water developments, better access) also exists with this alternative.

4.6.3.3 Alternative B

Implementation of Alternative B would remove about 1,613 acres from forage production during the construction phase of development operations, or about 167 AUMs. This represents a loss in stocking levels of about 0. percent throughout the GWA II analysis area. Once the well sites, pipeline corridors, and access road ROW's have been properly revegetated, about 15 AUMs would be brought back into production, resulting in a long-term forage loss of about 152 AUMs (approximately 0.4 percent of the GWA II analysis area). As with Alternative A, this level of reduction should not affect the livestock use in the GWA II analysis area.

The potential for livestock theft, and loss from vehicular collision, and the potential for introduction of weed species also exists as discussed in the Proposed Action and Alternative A, but to a lesser degree. Also, the potential for enhancing livestock operations (water developments, better access) also exists with implementation of Alternative B.

4.6.3.4 Alternative C - No Action

Under Alternative C - No Action the conditions described in Chapter 3, Affected Environment would generally remain unchanged. Disturbances to range resources located in close proximity to roaded areas and existing production facilities would continue due to vehicular use.

4.6.4 Impacts Summary

Impacts to the range resource would involve loss of livestock forage, potential for livestock loss through theft or vehicular collision, and the introduction of weed species. However, with implementation of the Mitigation Measures proposed by UPRC and other GWA II operators (Chapter 2), and stipulations in the RMP, impacts to range resources can be avoided or reduced to acceptable levels.

4.6.5 Cumulative Impacts

Existing land management and use activities that have impacted the GWA II analysis area to varying degrees include livestock grazing, road construction and use, and construction of other well sites and pipelines. The additional area of disturbance resulting from implementation of either the Proposed Action, Alternative A, or Alternative B would not substantially add to the cumulative impacts already occurring in the area. Other vegetative and range resource disturbances are occurring on lands adjacent to, and in the vicinity of the GWA II project area (Chapter 1). Implementation of any alternative would add to the cumulative amount of disturbance to vegetation and range due to these projects. However, significant cumulative impacts are not anticipated.

4.6.6 Mitigation Summary

No additional mitigation beyond that incorporated into Chapter 2 and the RMP would be necessary.

4.6.7 Residual Impacts

There would be no residual impacts to range resources or other land uses as a result of implementation of the Proposed Action or alternatives.

4.7 WILDLIFE

4.7.1 Introduction

The principle impacts likely to be associated with the proposed field development project include: 1) a direct loss of wildlife habitat; 2) the displacement of some wildlife species; 3) an increase in the potential for collisions between wildlife and motor vehicles; and 4) an increase in the potential for the illegal kill and harassment of wildlife.

4.7.2 Impact Significance Criteria

Impacts related to this project would be considered significant if any of the following were to occur:

- non-compliance with existing BLM, FWS, or WGFD management objectives for wildlife, or BLM wildlife stipulations for surface occupancy criteria on natural gas mineral developments;

- a collective increase in direct mortality of wildlife due to: road kill, poaching, harassment, or other causes, which exceeds existing levels by an amount that makes agency wildlife population goals unachievable;

- the displacement of animals from crucial habitat and accompanying stress during an important use period;

- the permanent reduction in size by more than one percent, the elimination, or otherwise rendering unsuitable for wildlife an officially designated crucial habitat;

- any effect, whether direct or indirect, that results in long-term decreases in recruitment and/or survival of individuals in a wildlife population;

- disruption of grouse or raptor breeding or nesting activities;

Impacts to species of special concern including listed threatened and endangered species, species proposed for listing, FWS or state sensitive species and federal candidate species would be considered significant if any of the following were to occur:

- if the Biological Assessment (produced as a separate document), according to Section 7 of the Endangered Species Act (ESA) of 1973, concludes a "May Affect" determination, BLM will initiate formal consultation with FWS;

- the loss (death) of any individual from direct or indirect project-related causes including, but not limited to, recruitment rate reductions to viable populations;

- project-related impacts that jeopardize or substantially decelerate the recovery program for any species of concern.

4.7.3 Direct and Indirect Impacts

4.7.3.1 Proposed Action

The construction of new drill sites, the compressor station, and the related access roads/pipelines would result in the physical removal of approximately 1,500, seven, and 909 acres of wildlife habitat, respectively, for a total of 2,416 acres. Following construction, the impact would be reduced after reclamation of areas no longer needed to continue the operation.

The physical removal of 2,416 acres of wildlife habitat associated with the construction of drill sites and access roads will reduce habitat availability for a variety of common small mammals, birds, reptiles, amphibians, and their predators. Because of the small amount of habitat lost in relation to the large amount of comparable habitats on the analysis and in the region, no adverse effects to the populations of these species is expected. The duration of this impact may be short-term or long-term depending on the production status of the wells.

4.7.3.1.1 Threatened and Endangered Wildlife Species

Black-footed Ferret. If black-footed ferrets inhabit the GWA II analysis area, the potential for the Proposed Action to significantly impact this species exists. Because of the large numbers of prairie dogs found on the area and the relatively large number and consistent history of ferret sightings reported for this area (HWA 1994b), the possibility of ferrets inhabiting this area cannot be discounted. Collectively, nearly 2 percent of the GWA II analysis area is covered by white-tailed prairie dog colonies. Nearly all of the 106 colonies found on GWA II analysis area occur south of I-80 with the main concentration located in the southern third of the area (Exhibit 3-4). During the past 20 years, five confirmed sightings and seven probable sightings have been reported within a 30-mile radius of the GWA II analysis area.

Potential impacts to this species that are associated with project activities include: 1) increased possibility for being struck by moving vehicles on existing and new roads; 2) increased possibility for being mistakenly shot as a prairie dog; 3) possibility of being buried or otherwise injured if construction activities overlap active prairie dog burrows.

In order to avoid impacting this species, consultation with the FWS to determine the necessity of conducting black-footed ferret searches prior to construction is recommended. The size, location, and burrow densities of prairie dog colonies on the GWA II analysis area has been described in detail in a wildlife technical report for the Greater Wamsutter Area II (HWA 1994a). If the Proposed Action is coordinated with the BLM and FWS, and the prescribed avoidance and mitigation measures listed in Section 2.3.4.2.7 and Appendix A are applied, impacts to this species are unlikely to occur.

Bald Eagle. Bald eagles that pass through the region may be attracted to road-killed wildlife, particularly during the winter months, and therefore would be more vulnerable to injury or death from vehicle traffic. The death of one bald eagle would constitute a significant impact. Due to the absence of open water, roosting trees, and a suitable prey base, bald eagles are not expected to frequent the area. Although several winter sightings of bald eagles have been made on and within a few miles of the boundaries of the GWA II analysis area, their use of the area is likely to be limited to occasional hunting flights in search of winter food. Although a small potential exists for vehicles colliding with bald eagles feeding on road-killed carrion during the winter months, the construction and operation of the project are not likely to adversely affect this species.

Peregrine Falcon. Although the GWA II analysis area appears to provide suitable habitat, the peregrine falcon is unlikely to occur on the project area or in the region except as an occasional migrant. There is no evidence that indicates the GWA II analysis area is used by the peregrine falcon and, therefore, implementation of the Proposed Action is not expected to adversely affect this species.

Whooping Crane. Wetlands are extremely limited within the GWA II analysis area and since there is no evidence indicating the GWA II analysis area is used by the whooping crane, implementation of the Proposed Action is not expected to adversely affect this species.

4.7.3.1.2 Candidate Wildlife Species

White-Faced Ibis. Waterfowl and shorebird nesting habitat is limited within the GWA II analysis area because of the ephemeral nature of the water supply. Although the white-faced ibis has been observed on and near the GWA II analysis area on occasion, including sightings on two different locations during the 1994 field surveys (HWA 1994a), it is likely that the use of the area by this species is only for resting and feeding during migration. Because the habitats that are normally used by white-faced ibis for nesting (extensive waterbodies with dense stands of cattails or reeds) (Dinsmore 1983) are nearly non-existent on GWA II analysis area, it is not likely that this species nests here. However, because two birds that appeared to be pair-bonding were observed on Red Lake on May 6, 1994, the possibility of nesting cannot be ruled out.

Impacts could be prevented by avoiding construction within suitable ibis nesting habitat from late April through mid-July. If construction is not planned within this time period, a search of the construction site would determine whether or not ibises were there. If nesting ibises were discovered, the FWS would be contacted and a consultation on required action requested. Given the application of these measures, adverse impacts to this species are unlikely.

Ferruginous Hawk. The ferruginous hawk is a common inhabitant of GWA II analysis area and nests throughout the area. Although 51 nests of this species have been found during the 1994 BLM survey and the 1992 HWA survey, only eight active nests were located. The majority of these nests occur along the Delaney Rim in the southwestern portion of the GWA II analysis area and in rock outcrops and prominances throughout the area.

Although the potential to impact the ferruginous hawk exists, adverse effects are unlikely with the application of prescribed avoidance and mitigation measures listed in Section 2.3.4.2.7 and Appendix A. These measures prohibit construction activities within 0.75 miles during the critical nesting season.

Columbian Sharp-Tailed Grouse. No impacts to the Columbian sharp-tailed grouse are anticipated due to the lack of suitable habitat for this species within the GWA II analysis area.

Mountain Plover. Mountain plovers were sighted during the 1994 field surveys (HWA 1994a) and large amounts of apparently suitable habitat for this species occurs in the southern third of the area. Even though sightings of this species in the area are not numerous, it is possible that relatively large numbers of them occur there.

Nesting locations of this species are difficult to determine because the birds nest independently and can be sporadically spaced (Ritter 1992). Because the status of nests changes between years, activity status and location must be current to allow the planning of mitigation and the avoidance of impacts.

A significant impact to the mountain plover would occur if an active nest were disturbed during the incubation period or if the nest was disturbed before the chicks were mobile. This impact could be prevented by avoiding construction within suitable mountain plover nesting habitat from late April through mid-July. If construction is planned within this time period, a search of the construction site would determine the occurrence of mountain plover. If nesting mountain plovers were discovered, the USFWS would be contacted and a consultation on required action requested. Given the application of these measures, adverse impacts to this species are unlikely.

Long-Billed Curlew. No impacts to the long-billed curlew are anticipated due to the lack of suitable habitat for this species within the GWA II analysis area.

Black Tern. No impacts to the black tern are anticipated due to the lack of suitable habitat for this species within the GWA II analysis area.

Loggerhead Shrike. Loggerhead shrikes, including breeding pairs, were sighted during the 1994 field surveys (HWA 1994a) and suitable nesting habitat for this species occurs in several of the larger draws and drainage basins in the southern third of the area.

A significant impact to the loggerhead shrike would occur if an active nest were disturbed during the incubation period or if the nest was disturbed before the chicks were mobile. This impact could be prevented by avoiding construction within suitable loggerhead shrike nesting habitat from late April through mid-July. If construction is planned within this time period, a search of the construction site would determine whether or not suitable habitat existed and, if present, whether or not shrikes were present. If nesting loggerhead shrikes were discovered, the USFWS would be contacted and a consultation on required action would be requested. Given the application of these measures, adverse impacts to this species are unlikely.

4.7.3.1.3 Big Game

Impacts to all big game species include the loss of habitat due to well, road and pipeline development; displacement due to increased human activities; increased potential for vehicular collisions due to new roads and increased traffic levels on existing roads; and increased poaching due to easier access and increased human activities. The amount of habitat loss depends on the seasonal use of the area by each species and the corresponding drilling schedule. Also, displacement due to human disturbance is more pronounced in the short term and the magnitude depends on the ability of a species to habituate to disturbance. Habitat summaries and disturbance responses for each big game species are presented below.

Pronghorn Antelope. The Proposed Action involves the placement of up to 300 new well locations, some of which could be drilled within crucial antelope winter range (Exhibit 3-5). The amount of crucial winter habitat removed would depend on the number of new well locations constructed, with a loss of approximately 8.03 acres per drilling site and associated access roads. Considering the size of the crucial range and spacing limitations of the production field, a range of from 17 to 43 new well locations could be constructed within crucial winter range for antelope. The smaller of these two numbers (17) represents the mean or average density of new well locations, assuming that the 300 new wells are evenly distributed over the 522.17 square miles of the GWA II analysis area. The larger of the two numbers (43) represents the maximum number of wells that are allowable on this area (the crucial antelope winter range) in order to bring the well density up to the allowable maximum of two sites per square mile. In calculating this number, the average density of existing wells on the GWA II analysis area (0.5 wells per 640 acres)(Table 2-9) was subtracted from the WOGCC approved two wells per 640 acres, which would allow an additional 1.5 wells per square mile.

The construction of 17 new well locations in this habitat would initially result in the direct removal of approximately 137 acres of habitat on this crucial range, or 0.74 percent of the crucial winter range which covers approximately 18,506 acres. The remaining 283 wells and associated roads would remove approximately 2,279 acres of winter/year-long and spring/summer/fall pronghorn habitats. In the long term, following reclamation and assuming production on all well sites, approximately 78 acres of crucial winter range, (0.42 percent), and 1,285 acres of winter/year-long and spring/summer/fall range would remain impacted. This amount of habitat loss by itself is not considered to be significant, but must be evaluated in the context of cumulative impacts (Section 4.7.5) in order to assess the magnitude of overall effects.

The construction of 43 new well locations in this habitat would initially result in the direct removal of approximately 345 acres of habitat on this crucial range, or approximately 1.87 percent of the crucial winter range which covers approximately 18,506 acres on GWA II. The remaining 257 wells and associated roads would remove approximately 2,071 acres of winter/year-long and spring/summer/fall pronghorn habitats. In the long term, following reclamation and assuming production on all well sites, approximately 195 acres of crucial winter range, or 1.05 percent of the total crucial range in that area, and 1,168 acres of winter/year-long and spring/summer/fall range would be lost. This amount of habitat loss by itself may not be significant, but must be evaluated in the context of cumulative impacts (Section 4.7.5) in order to assess the magnitude of overall effects. Surface impacts to crucial range could be minimized through avoidance and the use of directional drilling.

With the application of avoidance and mitigation measures described above and in Section 2.3.4.2.7 and Appendix A and, in consideration of the cumulative impacts analysis in Section 4.7.5, significant impacts to crucial winter habitat of pronghorn are not expected.

In addition to the direct loss of habitat due to construction of well pads and roads, disturbances from drilling activities and traffic would affect utilization of the habitat immediately adjacent to these areas. However, pronghorn have been found to habituate to increased traffic volumes (Reeve 1984) and heavy machinery as long as the machines moved in a predictable manner, but deviation from the ordinary can cause antelope displacement (Segerstrom 1982). After construction, when traffic and human activity is greatly reduced and habituation has taken place, this impact would be minimal.

The potential for vehicular collisions with pronghorn would increase due to new roads and increased traffic levels on existing roads. This potential impact is discussed in more detail in Section 4.7.3.1.6.

Mule Deer. No officially-designated crucial mule deer habitats occur on the GWA II analysis area, and most of the northern portion of the area (118,016 acres) is not classified as mule deer habitat at all (Exhibit 3-6). Approximately 194 of the 300 proposed well locations (64.7 percent) would be drilled within approximately 216,175 acres of year-long and winter/year-long range of mule deer. The other 106 well locations would not be within designated mule deer range. Total well and road construction would initially result in the removal of approximately 1,563 acres of habitat in the designated mule deer range. After construction and initial reclamation, assuming that all wells are productive, a maximum of approximately 882 acres of mule deer habitat would be impacted in the long term. Since no crucial habitat will be affected by this project, no significant impact to mule deer populations is expected.

An additional loss of habitat could occur when mule deer are displaced from the habitat immediately surrounding the project sites. This impact would occur in the short term during the construction phase of the project. Over time, levels of human activity would decrease as wells are shut down or put into production and animals would have had time to habituate over the long term.

Mule deer wintering along I-80 in southern Wyoming showed little concern for traffic (Ward et al. 1980). In Montana, a 10-year study of the effects of surface coal mining on mule deer showed that despite extensive increases in mining disturbance and activity over a 680-square-mile area, the mule deer population increased over 600 percent in an 8-year period (Phillips et al. 1986). An extreme case of tolerance to humans was documented by Crockett and Green (1986) who describe the management problems created by a mule deer population that colonized the western edge of the city of Boulder, Colorado and use it as year-round habitat.

Elk. No officially-designated crucial elk habitats occur on the GWA II analysis area, and most of the area is not classified as elk habitat at all (Exhibit 3-7). Approximately 28,224 acres of elk year-long range occur in the northeastern corner of the GWA II analysis area. Considering the size of this range and spacing limitation of the production field, a maximum of twenty-three of the 300 proposed well locations (7.7 percent) could be drilled within elk year-long range. Total well and road construction would initially result in the direct removal of approximately 185 acres of habitat. Long-term impacts after initial reclamation, assuming all wells are productive, would be reduced to 104 acres. The remaining 277 well locations and associated roads would not be within designated elk range. Because the Proposed Action will affect relatively little elk habitat and no crucial elk range, significant impacts to this species due to habitat loss are not expected.

In addition to the direct loss of habitat due to construction of well pads and roads, disturbances from drilling activities and traffic would affect utilization of the habitat immediately adjacent to these areas. Because elk have been found to habituate to disturbances that are repetitive and predictable (Johnson 1982), and the decrease in human activity in the area following well construction, this impact would only occur for the short-term and is not expected to be significant.

4.7.3.1.4 Sage Grouse

Twenty-one sage grouse leks have been documented on the GWA II analysis area and 11 were found to be active during 1992 and 1994 surveys (Exhibit 3-8). The Proposed Action could displace nesting birds if construction is performed within a 2-mile radius of an active lek during the spring or early summer (March to June) and it may disrupt breeding activities near the lek during the strutting season (March and April). Collectively, those well locations that fall within the 2-mile radius of leks could result in a significant loss of nesting habitat. Such losses of nesting habitat could be minimized by the selective placement of well locations outside of such 2-mile radii and by using sagebrush in the species mix when reclaiming these areas.

Artificial nesting structures constructed specifically for use by raptors should be located outside the 2-mile nesting radius of known leks. Measure 9 in Section 2.3.4.2.7 states that no activities or surface use will be allowed within 0.25 miles of an existing sage grouse lek, and Measure 10 requires that surface disturbance not be allowed from March through mid-June within a distance specified in the applicable lease stipulation. Exceptions and modifications to these requirements may be granted through consultation with the BLM AO.

Although the potential to impact sage grouse exists, adverse effects are unlikely with the application of prescribed avoidance and mitigation measures listed above and in Section 2.3.4.2.7, and Appendix A.

4.7.3.1.5 Raptors

Sixty-four raptor nests have been documented on and within 1/2-mile of the GWA II analysis area, and eight (ferruginous hawks) were found to be active during the 1992 survey by HWA and the 1994 survey by BLM. The condition of the majority of the historical nests indicated they had not been used in a number of years and, in some cases, were little more than a few scattered sticks on a ledge. Several nests are no longer identifiable as raptor nests.

Scattered sightings of burrowing owls on prairie dog colonies on the GWA II analysis area have been reported in the WOS (WFGD 1981), and by HWA (1992, and 1994a). Any habitat alterations that affect openness, vegetation height, prairie dog densities, and burrow availability have the potential to influence burrowing owl populations. Of these four components, short vegetation height and burrow availability are the most critical for maintaining owl populations (Marks and Ball 1983). Possible impacts to burrowing owls could be minimized by avoiding the placement of well locations, roads, and pipelines within active prairie dog colonies.

The Proposed Action could displace nesting birds if construction is performed too close to an active nest during the spring nesting season. Measure 7 in Section 2.3.4.2.7 states that construction during the critical nesting season will be restricted when an active raptor nest occurs within 0.75 miles of a proposed well location.

Although the potential to impact raptors exists, adverse effects are unlikely with the application of prescribed avoidance and mitigation measures above, Section 2.3.4.2.7, and Appendix A.

4.7.3.1.6 Vehicle Collisions

An increase in potential for vehicular collisions with wildlife would occur as a result of new road construction and from increasing traffic levels on existing roads. The potential for this impact increases during winter months, during nocturnal and twilight periods, with vehicle speed, and with driver ignorance or disregard. On the higher-speed roads there is some potential for carrion-eating raptors (e.g. golden eagles to be struck by motor vehicles while feeding on road-killed animals.

After the drilling phase is completed, this impact decreases greatly as traffic decreases. During the production phase only occasional well inspections occur rather than the continuous activity associated with the drilling phase.

The terrain associated with the Proposed Action is generally fairly level and contains predominately shrub and grassland habitat. Consequently, drivers can see relatively long distances and are aware of wildlife on the road well before possible collisions occur.

During field reconnaissance of the area no wildlife carcasses were observed adjacent to the extensive existing roads, indicating vehicle collisions are infrequent.

Although the potential for increased vehicular collisions exists, significant adverse effects are unlikely with the application of prescribed avoidance and mitigation measures listed in Section 2.3.4.2.7 and Appendix A.

4.7.3.1.7 Human Harassment

Roads and associated human activity create the potential for harassment of all species of wildlife. Big game species are especially vulnerable to increased harassment in the form of poaching. Due to the existing road network in the area, the potential for harassment already exists and is not expected to increase significantly due to the increase in roads. However, the temporary increase in work force associated with the drilling program will moderately increase the potential for illegal kill and harassment of wildlife. The potential for this type of impact should return to existing levels following the completion of the drilling and intensive construction phase of the project.

In order to reduce incidents of illegal kill and harassment of wildlife, all project workers should be instructed on local wildlife regulations, and state wildlife laws and regulations should be posted in conspicuous places at the job sites and workers would not be allowed to carry firearms. Personnel should also be instructed about the nature of the wildlife species that occur on the work site, potential impacts to these species, and measures that could be taken to avoid or minimize impacts. Project workers will report raptor nests, sage grouse leks and other noteworthy wildlife occurrences to the WGFD and the BLM.

Although the potential for increased human harassment exists, significant adverse effects are unlikely with the application of prescribed avoidance and mitigation measures listed above and in Section 2.3.4.2.7 and Appendix A.

4.7.3.2 Alternative A

The construction of new drill sites and the related access roads, compressor station, and pipelines would result in the physical removal of approximately 1,250 seven, and 757.5 acres of wildlife habitat, respectively, for a total of 2,015 acres. Following construction, the impact would be reduced after reclamation of areas no longer needed to continue the operation.

The types of impacts under this alternative are identical to those described under the Proposed Action; however, the magnitude of potential impacts under Alternative A is somewhat less than the Proposed Action because of the smaller number of well locations, and miles of road and pipeline proposed. The analysis of impacts to wildlife for this alternative are based on the entire GWA II analysis area in total rather than on specific designated drilling area well sites since specific sites have not been designated.

4.7.3.2.1 Threatened and Endangered Species

Black-footed Ferret. The analysis for Alternative A is identical to that previously described under the Proposed Action. The potential for impacting this species, if present, is moderately lower than the Proposed Action in that 50 fewer well locations will be constructed and 335 fewer acres would be disturbed.

Bald Eagle. The analysis for Alternative A is identical to that previously described under the Proposed Action.

Whooping Crane. The analysis for Alternative A is identical to that previously described under the Proposed Action.

4.7.3.2.2 Candidate Wildlife Species

White-Faced Ibis. The analysis for Alternative A is identical to that previously described under the Proposed Action.

Ferruginous Hawk. The analysis for Alternative A is identical to that previously described under the Proposed Action. The potential for impacting this species is moderately lower than the Proposed Action in that 50 fewer well locations will be constructed. Initially, 402 fewer acres would be disturbed, but in the long term, following reclamation and assuming production on all well sites, 226 fewer acres would be disturbed.

Columbian Sharp-Tailed Grouse. The analysis for Alternative A is identical to that previously described under the Proposed Action.

Mountain Plover. The analysis for Alternative A is identical to that previously described under the Proposed Action. The potential for impacting this species is moderately lower than the Proposed Action in that 50 fewer well locations will be constructed. Initially, 402 fewer acres would be disturbed, but in the long term, following reclamation and assuming production on all well sites, 226 fewer acres would be disturbed.

Long-Billed Curlew. The analysis for Alternative A is identical to that previously described under the Proposed Action.

Black Tern. The analysis for Alternative A is identical to that previously described under the Proposed Action.

Loggerhead Shrike. The analysis for Alternative A is identical to that previously described under the Proposed Action. The potential for impacting this species is moderately lower than the Proposed Action in that 50 fewer well locations will be constructed. Initially 402 fewer acres would be disturbed, but in the long term, following reclamation and assuming production on all well sites, 226 fewer acres would be disturbed.

4.7.3.2.3 Big Game

Pronghorn Antelope. The analysis for Alternative A is identical to that previously described under the Proposed Action, but the potential for impacting this species is moderately lower than the Proposed Action in that 50 fewer well locations will be constructed. Initially 402 fewer acres would be disturbed, but in the long term, following reclamation and assuming production on all well sites, 226 fewer acres would be disturbed.

Mule Deer. The analysis for Alternative A is identical to that previously described under the Proposed Action. The potential for impacting this species is moderately lower than the Proposed Action in that 50 fewer well locations will be constructed. Initially 402 fewer acres would be disturbed, but in the long term, following reclamation and assuming production on all well sites, 226 fewer acres would be disturbed.

Elk. The analysis for Alternative A is identical to that previously described under the Proposed Action. The potential for impacting this species is moderately lower than the Proposed Action in that 50 fewer well locations will be constructed. Initially 402 fewer acres would be disturbed, but in the long term, following reclamation and assuming production on all well sites, 226 fewer acres would be disturbed.

4.7.3.2.4 Sage Grouse

The analysis for Alternative A is identical to that previously described under the Proposed Action. The potential for impacting this species is moderately lower than the Proposed Action in that 50 fewer well locations will be constructed. Initially 402 fewer acres would be disturbed, but in the long term, following reclamation and assuming production on all well sites, 226 fewer acres would be disturbed.

4.7.3.2.5 Raptors

The analysis for Alternative A is identical to that previously described under the Proposed Action. The potential for impacting this species is moderately lower than the Proposed Action in that 50 fewer well locations will be constructed. Initially 402 fewer acres would be disturbed, but in the long term, following reclamation and assuming production on all well sites, 226 fewer acres would be disturbed.

4.7.3.2.6 Vehicle Collisions

The analysis for Alternative A is identical to that previously described under the Proposed Action except that the potential for impacting wildlife is moderately lower than the Proposed Action in that 50 fewer well locations and associated roads will be constructed. Initially 402 fewer acres would be disturbed, but in the long term, following reclamation and assuming production on all well sites, 226 fewer acres would be disturbed.

4.7.3.2.7 Human Harassment

The analysis for Alternative A is identical to that previously described under the Proposed Action except that the potential for impacting wildlife is moderately lower than the Proposed Action in that 50 fewer well locations and associated roads will be constructed and the construction workforce would be in place proportionately less time. Initially 402 fewer acres would be disturbed, but in the long term, following reclamation and assuming production on all well sites, 226 fewer acres would be disturbed.

4.7.3.3 Alternative B

The construction of new drill sites and the related access roads, compressor station, and pipelines would result in the physical removal of approximately 1,000, seven, and 606 acres of wildlife habitat, respectively, for a total of 1,613 acres. Following construction, the impact would be reduced after reclamation of areas no longer needed to continue the operation.

The types of impacts under this alternative are identical to those described under the Proposed Action and Alternative A, however, the magnitude of potential impacts under Alternative B is somewhat less than the Proposed Action or Alternative A because of the smaller number of well locations, and miles of road and pipeline proposed. The analysis of impacts to wildlife for this alternative is based on the entire GWA II analysis area in total rather than on specific designated drilling area well sites since specific sites have not been designated.

4.7.3.3.1 Threatened and Endangered Species

<u>Black-footed Ferret</u>. The analysis for Alternative B is identical to that previously described under the Proposed Action. However, the potential for impacting this species, if present, is lower than for the Proposed Action in that 100 fewer well locations will be constructed. Initially 803 fewer acres would be disturbed, but in the long term, following reclamation and assuming production on all well sites, 452 fewer acres would be disturbed.

<u>Bald Eagle</u>. The analysis for Alternative B is identical to that previously described under the Proposed Action.

<u>Whooping Crane</u>. The analysis for Alternative B is identical to that previously described under the Proposed Action.

4.7.3.3.2 Candidate Wildlife Species

White-Faced Ibis. The analysis for Alternative B is identical to that previously described under the Proposed Action.

Ferruginous Hawk. The analysis for Alternative B is identical to that previously described under the Proposed Action. However, the potential for impacting this species, is lower than the Proposed Action in that 100 fewer well locations will be constructed. Initially 803 fewer acres would be disturbed, but in the long term, following reclamation and assuming production on all well sites, 452 fewer acres would be disturbed.

Columbian Sharp-Tailed Grouse. The analysis for Alternative B is identical to that previously described under the Proposed Action.

Mountain Plover. The analysis for Alternative B is identical to that previously described under the Proposed Action. However, the potential for impacting this species is lower than for the Proposed Action in that 100 fewer well locations will be constructed. Initially 803 fewer acres would be disturbed, but in the long term, following reclamation and assuming production on all well sites, 452 fewer acres would be disturbed.

Long-Billed Curlew. The analysis for Alternative B is identical to that previously described under the Proposed Action.

Black Tern. The analysis for Alternative B is identical to that previously described under the Proposed Action.

Loggerhead Shrike. The analysis for Alternative B is identical to that previously described under the Proposed Action. However, the potential for impacting this species is lower than the Proposed Action in that 100 fewer well locations will be constructed. Initially 803 fewer acres would be disturbed, but in the long term, following reclamation and assuming production on all well sites, 452 fewer acres would be disturbed.

4.7.3.3.3 Big Game

Pronghorn Antelope. The analysis for Alternative B is identical to that previously described under the Proposed Action. The potential for impacting mule deer is lower than the Proposed Action in that 100 fewer well locations will be constructed. Initially 803 fewer acres would be disturbed, but in the long term, following reclamation and assuming production on all well sites, 452 fewer acres would be disturbed.

Mule Deer. The analysis for Alternative B is identical to that previously described under the Proposed Action. The potential for impacting mule deer is lower than the Proposed Action in that

100 fewer well locations will be constructed. Initially 803 fewer acres would be disturbed, but in the long term, following reclamation and assuming production on all well sites, 452 fewer acres would be disturbed.

Elk. The analysis for Alternative B is identical to that previously described under the Proposed Action. The potential for impacting elk is lower than the Proposed Action in that 100 fewer well locations will be constructed. Initially 803 fewer acres would be disturbed, but in the long term, following reclamation and assuming production on all well sites, 452 fewer acres would be disturbed.

4.7.3.3.4 Sage Grouse

The analysis for Alternative B is identical to that previously described under the Proposed Action. The potential for impacting sage grouse is lower than the Proposed Action in that 100 fewer well locations will be constructed. Initially 803 fewer acres would be disturbed, but in the long term, following reclamation and assuming production on all well sites, 452 fewer acres would be disturbed.

4.7.3.3.5 Raptors

The analysis for Alternative B is identical to that previously described under the Proposed Action. The potential for impacting raptors is lower than the Proposed Action in that 100 fewer well locations will be constructed. Initially 803 fewer acres would be disturbed, but in the long term, following reclamation and assuming production on all well sites, 452 fewer acres would be disturbed.

4.7.3.3.6 Vehicle Collisions

The analysis for Alternative B is identical to that previously described under the Proposed Action except that the potential for impacting wildlife is lower than the Proposed Action in that 100 fewer well locations and associated roads will be constructed. Initially 803 fewer acres would be disturbed, but in the long term, following reclamation and assuming production on all well sites, 452 fewer acres would be disturbed.

4.7.3.3.7 Human Harassment

The analysis for Alternative B is identical to that previously described under the Proposed Action except that the potential for impacting wildlife is lower than the Proposed Action in that 100 fewer well locations and associated roads will be constructed and the construction workforce would be in place proportionately less time. Initially 803 fewer acres would be disturbed, but in the long term, following reclamation and assuming production on all well sites, 452 fewer acres would be disturbed.

4.7.3.4 Alternative C - No Action

As a result of the "No Action" alternative, impacts related to the wildlife resources within the unit area and adjacent lands would continue at current levels. These impacts consist mainly of hunters who travel the existing access roads, current oil and gas developments, and livestock grazing and associated activities. Implementation of this alternative would maintain the current level of human activity and associated impacts.

4.7.4 Impacts Summary

Impacts and potential impacts to wildlife are classified into three basic categories. The first category includes technically significant impacts that have the potential to occur but would be unlikely to occur if prescribed avoidance measures are implemented. The second category includes technically significant impacts that would occur but that could be reduced to non-significant levels through the application of prescribed mitigation measures. The third category includes other important, but technically non-significant potential impacts for which avoidance or mitigation measures may or may not have been prescribed.

First category impacts include the following: 1) increased potential for illegal kill and harassment of wildlife; 2) potential for disruption of raptor and sage grouse nesting activities; 3) potential for striking bald eagles with vehicles; 4) potential to adversely impact black-footed ferrets; 5) potential for displacement of pronghorn from crucial winter range; and 6) potential to adversely affect nesting ferruginous hawks, mountain plovers, loggerhead shrikes and white-faced ibises

Second category impacts include the following: 1) long-term loss of sage grouse nesting habitat; 2) increase in potential for wildlife/vehicle collisions; and 3) long-term loss of crucial big game winter range.

Third category impacts include the following: 1) long-term and short-term losses of non-crucial habitat of wildlife, and 2) temporary displacement of wildlife during the construction period.

Direct loss of wildlife habitat would result from the clearing of existing vegetation from the drill sites and access roads. Pipelines would be constructed in association with the access roads and would not increase the amount of habitat loss. For wells that are dry holes, this impact would be short-term and would persist only until the application of appropriate reclamation procedures and natural biotic succession restore the disturbed area to predisturbance use levels. For wells that produce, this impact would persist throughout the life of the well. On productive wells, approximately 24 percent of the disturbed area will be reclaimed following completion of drilling.

Some wildlife species would be indirectly impacted by being displaced from habitats in the vicinity of the project area by the presence and activities of humans associated with construction and operation. The severity of this impact would decrease over time as wildlife habituate to the operation, but some degree of impact would remain as long as human activities continue. On dry holes, this impact would be short-term and would persist only until the well site is reclaimed and abandoned. On production wells, some reduced level of impact would persist throughout the life of the well.

The potential for collisions between wildlife and motor vehicles would increase due to the construction of new roads and increased traffic levels on existing roads leading to the project area. Such collisions result in death or injury to a variety of wildlife species and can produce a road-kill food chain whereby scavengers that feed on road-killed animals could in turn be struck by vehicles.

The potential for displacement, vehicular collisions, and poaching/harassment would be greater during the drilling construction phase when human activities on the area are at the maximum. The potential for these impacts would be reduced as wells are either reclaimed or put into production.

Although the nature of potential impacts to wildlife is identical between the Proposed Action and Alternatives A and B, the potential magnitude of impacts is highest under the Proposed Action, intermediate under Alternative A, and least under Alternative B. This is because of the difference in the number of wells and the associated increase in miles of new roads and pipelines constructed. Given the application of prescribed avoidance and mitigation measures listed in Section 2.3.4.2.7, Appendix A, and under individual species in Section 4.7, significant impacts to wildlife are not expected. Implementation of Alternative C would maintain the current level of human activity and associated impacts.

4.7.5 Cumulative Impacts

Cumulative impacts have been assessed on the basis of combining the effects from three different sources. These sources consist of: 1) other proposed, on-going, or recent projects within the area affected by the proposed action or alternatives; 2) existing or historical impacts; and 3) the action and alternatives proposed in this EIS.

Existing or historical impacts to pronghorn crucial ranges were calculated at the herd unit level for the GWA II analysis area. These calculations were limited to pronghorn since it is the only big game species that has crucial range on the GWA II analysis area. Calculations were performed for both the Red Desert and the Bitter Creek Herd Units. These calculations were performed by determining the existing surface area disturbances, in acres, that are visible on updated USGS (1981) 1:24,000 quad maps. Distances of linear disturbances, such as roads and railroads, were determined with a calibrated wheel and areas of disturbance determined by multiplying linear distance by average disturbed widths for the various grade levels of roads. Surface areas of other disturbances such as gravel pits, pumping stations, etc. were determined with a planimeter. More constant disturbances such as oil and gas wells were multiplied by a constant, average disturbance area to determine total area of disturbance. See Table 4-9 for totals.

Table 4-9. Cumulative Effects of Human Disturbance (Long-term) on Crucial Big Game (Pronghorn)[1] Habitats within Herd Units that Occur on the GWA II Analysis Area.

Acres of Crucial Habitat Lost				
	Herd Unit and Acres of Crucial Habitat			
	Red Desert 224,192 ac		Bitter Creek 194,304 ac	
	Acres	*Percent of Total*	*Acres*	*Percent of Total*
Existing/Historical	1,785.53	0.80	1,178.92	0.61
On-Going/Recent	60.0	0.027	582.9	0.30
Proposed Action - GWA II				
Scenario 1[2]	73.5	0.03	4.5	0.0023
Scenario 2[3]	194.36	0.09	---	---
TOTAL				
Scenario 1[2]	1,918.43	0.86	1,766.32	0.91
Scenario 2[3]	2,039.89	0.91	---	---

[1] The only crucial big game habitat that occurs on the GWA II analysis area is pronghorn winter and winter/yearlong range.

[2] Assumes average distribution or density of 300 total new well locations which would result in the construction of 17 sites within crucial range.

[3] Assumes maximum allowable density of 43 sites within crucial range.

Other activities and developments within the Great Divide Basin that were considered in the analysis of cumulative impacts of this project are: 1) the Mulligan Draw Natural Gas Production Project located southeast of the GWA-II; 2) the Hay Reservoir Gas Field Development Project located northeast of the GWA-II; 3) the Uinta Basin Lateral Pipeline extending south from Wamsutter; 4) the Creston/Blue Gap Gas Project to the east and southeast; 5) Cheyenne Stage I and II pipelines; 6) proposed Sandstone Reservoir; 7) Moxa Arch expansion; 8) proposed

Carbon County underground coal gassification; 9) Kennecott Green Mountain Mine; and 10) the collective past developments of the region. Of these, the Creston/Blue Gap Gas Project is most critical due to its closeness (immediately adjacent) and size (250 well potential). Only project numbers 1, 4, and 10 would add impacts to the actions and alternatives proposed in this EIS. Although numbers 1 and 9 are located within the Red Desert Herd Unit, none of the facilities of either project are located on pronghorn crucial range. Number 3 has been completed and the pipeline corridor reclaimed and was not considered to be an impact for purposes of this analysis. Number 5, 6, 7, and 8 are located outside of either of the big game herd units occurring on the GWA II analysis area.

Other species of wildlife could be cumulatively affected by these other projects on a regional basis, but would not be because of the application of avoidance and mitigation measures prescribed in the respective NEPA analyses presented for each of these projects. Proposed projects would fall under the same requirements and would not be permitted if unavoidable significant impacts were to occur.

4.7.5.1 Pronghorn-Red Desert Herd Unit

Proposed On-Going/Recent Projects. The recent and on-going GWA I Project placed 10 new wells within crucial pronghorn habitat and resulted in the loss of 60 acres of habitat, or 0.027 percent of the total crucial habitat.

Existing/Historical Disturbances. As shown in Table 4-9, a total of 1,785.53 acres of the 224,192 acres of crucial winter-winter/yearlong pronghorn habitats in the Red Desert Herd Unit has already been disturbed and constitutes 0.8 percent of the total crucial habitat.

Proposed Action and Alternatives for the GWA II Analysis Area. Considering the size of the crucial range and spacing limitations of the production field, a range of from 17 to 43 new well locations could be constructed within crucial winter range for antelope. The addition of 17 wells would result in the loss of 73.5 acres, or 0.03 percent, of the crucial range. If the maximum of 43 wells was added, 194.36 acres, or 0.09 percent, of the crucial range would be lost.

4.7.5.1.1 Cumulative Impacts [Pronghorn-Red Desert Herd Unit]

The combination of impacts from recent/on-going, existing/historical, and proposed actions adds up to a total of from 1,918.43 to 2,039.89 acres of crucial range lost, depending on whether 17 or 43 new wells are placed in this habitat as part of the Proposed Action. These total acreages represent cumulative losses of from 0.86 to 0.91 percent, respectively. Although these cumulative losses do not equal or exceed the 1.0 percent impact significance criterion, they are very close to it and the loss of only 323.49 to 202.03 more acres within this habitat are possible before total losses equal one percent.

4.7.5.2 Pronghorn-Bitter Creek Herd Unit

Proposed On-Going/Recent Projects. The draft Environmental Impact Statement for the Creston/Blue Gap Area (CBGA) Gas Project (USDI-BLM 1994d) indicates impacts to crucial pronghorn winter range with the loss of 185 acres of habitat, or 0.9 percent of the crucial range within the CBGA. At the herd unit level (Bitter Creek), 0.2 percent of the crucial winter range would be lost over the life of the project. The draft EIS (USDI-BLM 1994d) also indicated that an additional 0.1 percent of crucial winter range of pronghorn in the Bitter Creek Herd Unit would be lost from the Mulligan Draw Natural Gas Production Project.

Existing/Historical Disturbances. As shown in Table 4-9, a total of 1,178.92 acres of the 194,304-acre crucial winter/winter/yearlong pronghorn habitat in the Bitter Creek Herd Unit has already been disturbed (Table 4-9) and constitutes 0.61 percent of the total crucial habitat.

Proposed Action and Alternatives for the GWA II Analysis Area. Well spacing limitations of the production field would allow no more than a single well to be placed in the 206 acres of crucial winter range that occurs on the GWA II analysis area. The addition of this single well would result in the long-term loss of 4.5 acres or 0.0023 percent of the crucial range.

4.7.5.2.1 Cumulative Impacts [Pronghorn-Bitter Creek Herd Unit]

The combination of impacts from recent/on-going, existing/historical, and proposed actions adds up to a total of 1,766.32 acres of crucial range lost, or a cumulative loss of 0.91 percent. Although this cumulative loss does not equal or exceed the 1.0 percent impact significance criterion, it comes very close to it and the loss of only 176.72 more acres within this habitat is possible before total losses equal one percent.

4.7.5.3 Raptors

As shown in Table 2-9, the existing disturbance to land area on the GWA II analysis area totals 12,527 acres, or 3.74 percent of the GWA II analysis area. Initially, the actions and alternatives in this EIS would total from 1,613 to 2,416 additional acres, but in the long term, following reclamation and assuming production on all well sites, from 911 to 1,363 additional acres would be disturbed. It is not known how many well locations will fall within the 0.75-mile buffer zone around raptor nests, but there are 64 raptor nests (of which 8 were active ferruginous hawk nests and one an active golden eagle nest in 1994) on the GWA II analysis area and it is likely that some of them will be proximal to wells. The Creston/Blue Gap EIS (1994a) documents 119 potentially active raptor nests on the Creston/Blue Gap Project Area occur within the 0.75-mile buffer. Other projects in the region also have a collective potential to impact raptor nests. Given the implementation of standard BLM stipulations on all of these developments, however, the nests should be adequately protected and no significant cumulative impact is expected.

4.7.5.4 Sage Grouse

As shown in Exhibit 3-8, a total of 21 sage grouse leks occur on the GWA II analysis area. Although it is not known how many well locations will fall within the 2-mile nesting zone around sage grouse leks it is likely that some of the initally disturbed 1,613 to 2,416 acres of disturbance (long-term 911 to 1,363) associated with the actions and alternatives proposed in this EIS will be proximal to leks. The Creston/Blue Gap EIS (1994a) documents that 127 wells on the Creston/Blue Gap Project would occur within sage grouse nesting habitats. Other projects in the region also have a collective potential to impact sage grouse nesting habitat. However, given the implementation of standard BLM stipulations on all of these developments impacts to nesting habitats would be minimized. Given the mitigation and avoidance measures for sage grouse that are described in this chapter (Section 4.7), the actions and alternatives proposed for the GWA II analysis area project are not expected to significantly increase cumulative impacts to sage grouse.

4.7.5.5 Threatened and Endangered Species

Because of the expanses of white-tailed prairie dog colonies on the GWA II analysis area and in the region surrounding it, suitable habitat for the black-footed ferret exists. Because of the high correlation between the occurrence of these colonies and previous earth-disturbing activities associated with oil and gas development in this region, it appears likely that such activities have collectively contributed to the creation of suitable habitat for the black-footed ferret. Ironically, these same human activities can impact ferrets by increasing the potential for: 1) being struck by moving vehicles on existing and new roads; 2) being mistakenly shot as a prairie dog; and 3) being buried or otherwise injured if construction activities overlap active prairie dog burrows. Since all developmental activities in the region are governed by strict FWS and BLM guidelines regarding the inventory of prairie dog colonies and searches for black-footed ferrets, an impact to this species is unlikely.

Given implementation of mitigation stipulations for each of the proposed gas developments in this region, and applicable federal regulations, the potential for significant cumulative impacts to threatened and endangered species is low.

4.7.5.6 Candidate Species

Given the avoidance and mitigation measures described in this document, direct impacts to candidate species are unlikely on the GWA II analysis area. However, the collective or cumulative effects of habitat removal at the regional level may need to be addressed with avoidance and mitigation measures comparable to those described in this document in order to avoid a reduction in habitat carrying capacities for these species.

4.7.5.7 Other Wildlife

Given implementation of mitigation stipulations for each of the proposed gas developments in this region, and applicable federal regulations, the potential for significant cumulative impacts to other wildlife species is low.

4.7.5.8 Vehicle Collisions

The cumulative potential for vehicle collisions with wildlife is high when all of the new roads and increased traffic from the several projects in the area are considered collectively. However, with implementation of mitigation stipulations for each of these projects, this potential is not expected to reach significant levels.

4.7.6 Mitigation Summary

Given the implementation of avoidance and mitigation measures described in Section 2.3.4.2.7, Appendix A, and under individual species in Section 4.7, significant impacts are not expected.

4.7.7 Residual Impacts

Unavoidable impacts that would occur throughout the life of the project include: 1) a loss of some wildlife habitat; 2) some increase in potential for vehicle related wildlife injuries, stress, and mortality; 3) the displacement of sensitive wildlife species from some habitats; and 4) some increase in potential for disruption and mortality of wildlife from use of the area by the general public. Implementation of mitigation as summarized previously would mitigate or reduce impacts to levels not considered significant.

4.8 FISHERIES

4.8.1 Introduction

Implementation of the GWA II project would affect fish resources and associated values if construction and drilling activities resulted in: 1) increased stream sedimentation; 2) downstream water pollution from accidental discharge of toxic substances; and 3) water flow depletions from Muddy Creek or the Little Snake River.

No perennial streams occur on the GWA II analysis area which is drained primarily via the Washakie Basin which carries intermittent/ephemeral runoff events generated by spring snowmelt and summer thunderstorms southward into the Little Snake River. These drainages are dry much of the year, do not support fish life, and are classified as intermittent or ephemeral (Class 4) by the WDEQ. Also, as described in Section 4.5 (Water Resources), water used during drilling and construction would be nominal in volume (1,209 acre-feet) and would be obtained from State of Wyoming approved groundwater sources. The water pumped from these deep wells is drawn from aquifers that are isolated from Muddy Creek and the Little Snake River and which are not associated with any surface expression in these watersheds. Therefore, no water depletion that could affect Threatened, Endangered, or Candidate fish species would occur. There would be no impact to the fisheries resource, both within the GWA II analysis area and adjacent drainages.

4.8.2 Impact Significance Criteria

Impacts related to this project would be considered significant if any of the following were to occur:

- increased instream siltation results in a long-term reduction of downstream fish populations;
- stream channelization, culvert and bridge installations, or dewatering alters fish habitat and results in a long-term reduction in fish populations;
- stream contamination from spills of wastes and accidental releases of toxic substances results in a long-term reduction in downstream fish populations;
- the loss or death of threatened, endangered, or candidate species from direct or indirect project-related causes;
- project-related impacts jeopardize or substantially decelerate the recovery program of any threatened, endangered, or candidate species;
- uptake or discharge of water used for drilling and construction causes dewatering of fish waters or alteration of fish habitat resulting in long-term reduction in fish populations.

4.8.3 Direct and Indirect Impacts

4.8.3.1 Proposed Action

Although the intermittent tributary drainages on the GWA II analysis area do not support fish populations, construction and operation activities have the potential to deposit sediments and toxic substances into these stream courses during high water runoff that could affect downstream fish populations in the Little Snake River.

Four species of fish classified as Endangered and three species classified as Candidate 2 occur downstream from the GWA II analysis area. Endangered species include the Colorado squawfish, humpback chub, bonytail chub, and razorback sucker, and the Candidate 2 species include the Colorado River cutthroat trout, flannelmouth sucker, and roundtail chub. Although these species occur many miles downstream of the GWA II analysis area, flow depletions in upstream drainages could potentially affect survival and recovery of these species when the cumulative impacts of such depletions are assessed. See the Biological Assessment for a more detailed analysis of potential impacts to these species.

As described in detail in the Water Resources Section (4.5) the construction of roads, drill pads, and surface facilities could produce an increase in stream flow and a decrease in water quality in Muddy Creek by decreasing the infiltration of water into the soil and creating the potential for increasing surface runoff, erosion, and off-site sedimentation. The stream flow and sediment load of Muddy Creek are not likely to be significantly affected, however, because: 1) drainages are intermittent or ephemeral; 2) the topography of the GWA II analysis area is relatively gentle; and 3) the climate is dry. In addition, natural sediments are abundant in the large drainage basin of Muddy Creek.

The intermittent and ephemeral surface waters and shallow groundwater could be impacted if process fluids or poor quality groundwater used for industrial purposes were accidentally released. The design of facilities as closed systems and the confinement of storage tanks by berms will, however, minimize the potential for spills. Potential impacts to surface and shallow groundwater would be minimized by these precautions.

The number of channel crossings involving access roads and pipelines would be minimized because the construction and operation of such crossings could increase sedimentation, modify channel course and morphology, and alter streamflow. The proposed crossing sites, however, involve areas where the active channels are generally ephemeral, have gentle slopes and are of minimal width. Restrictions to natural flow velocities, upstream sedimentation and downstream scour will be minimized through design criteria and specifications. The application of these precautions will minimize the impacts of channel crossings.

Potential sedimentation impacts to surface water associated with road, well pad, and pipeline construction will be minimized through the application of sound civil engineering practices of road design and construction and compliance with appropriate BLM and county road standards (e.g. BLM Manual 9113). Such precautions would include the use of proper culvert size, erosion control measures at the discharge end of culverts, and the use of ditches on steep slopes.

As described in more detail in Section 4.5 (Water Resources), water used during drilling and construction would be nominal in volume. The 1,209 ac-ft of water required for this project would be obtained from State of Wyoming approved ground water sources.

The water pumped from these deep wells is drawn from aquifers that are isolated from Muddy Creek and the Little Snake River and which are not associated with any surface expression in these watersheds. Therefore, no water depletion that could affect Threatened, Endangered, or Candidate fish species would occur.

Given the incorporation of mitigation and avoidance measures described in this section (4.8), the Water Resources Section (4.5), and in Chapter 2 of this EIS, and in the 1988 BLM RMP for the Medicine Bow-Divide Resource Area, the potential for impacts to fisheries resources is low and significant impacts are not expected.

4.8.3.2 Alternatives A and B

Although the potential for impacts under Alternatives A and B is reduced from that of the Proposed Action, the analysis is identical to that described in Section 4.8.3.1 (Proposed Action). Given the incorporation of mitigation and avoidance measures described in this section (4.8), the Water Resources Section (4.5), and in Chapter 2 of this EIS, and in the 1988 BLM RMP for the Medicine Bow-Divide Resource Area, the potential for impacts to fisheries resources is low and significant impacts are not expected.

4.8.3.3 Alternative C - No Action

Under this alternative, fisheries resources within the analysis area would remain as described in Section 3.8.

4.8.4 Impacts Summary

Potential impacts to fisheries resources include the degradation of surface water quality, an increase in stream flow from surface runoff, and a decrease in stream flow from the consumption of groundwater. However, given the avoidance and mitigation measures proposed by UPRC, avoidance and mitigation measures described in this document (Section 4.8), and in the 1988 BLM RMP for the Medicine Bow-Divide Resource Area, no significant impacts are expected.

Because the endangered and candidate species are so far removed from the GWA II analysis area, no direct effects to them are anticipated. Although unforeseen, any potential indirect effects that might be created by water depletion impacts would be reduced to non-significant levels through implementation of the "Windy Gap Process" (see subsection below).

4.8.5 Cumulative Impacts

The cumulative effect of water depletion in the watersheds of the Colorado River System could result in the reduction of habitats for the Threatened, Endangered, and Candidate species that live there. According to the "Windy Gap Decision" of the FWS, any cumulative depletion in flow to the upper basin of the Colorado River System is considered to have a possible effect on the survival and recovery of these listed species. Although the flows of many tributaries in the upper basins have been modified, flow in the mainstem Green River is controlled by Flaming Gorge Dam, and the resultant impacts on fish habitat are difficult to assess. Therefore, the "Windy Gap

Process" was developed to facilitate the calculation of flow depletions on a cumulative basis and the assessment of user fees to promote recovery of these species through monitoring, research, habitat manipulation, and fish culture.

Analysis of the Proposed Action and Alternatives indicates that no project-generated depletion of waters feeding or connected to Muddy Creek or the Little Snake River will occur and no increase in cumulative impacts associated with such water depletion will occur.

4.8.6 Mitigation Summary

In the event that currently unforeseen events result in water depletion from Muddy Creek or the Little Snake River, UPRC and other operators would be required to support the "Windy Gap Process" conservation measure to offset possible impacts and avoid jeopardy to the endangered and candidate fish species of the mainstem Green River. Contribution of funds to the FWS should be based on average annual depletion of surface water flow that might result if alluvial water is used for construction and drilling operations.

No additional measures beyond those already presented in this section and in Chapter 2 of this analysis and the RMP would be required.

4.8.7 Residual Impacts

With full implementation of the mitigation measures contained in this section and in Chapter 2, no adverse residual impacts to fisheries are expected.

4.9 RECREATION

4.9.1 Introduction

Well drilling, testing and production operations, and associated site preparation and construction activities such as those proposed for the GWA II project area have the potential to cause major alterations to the recreation setting and recreation opportunities available to persons using the area. Some recreationists could be temporarily or permanently displaced from using certain locations associated with drilling and production activities. Displacement of recreationists could also result from changes in the numbers or distribution patterns of wildlife that attract hunters and wildlife observers to the area. The presence of construction and drilling equipment and associated increased evidence of human industrial activities in the area could reduce opportunities for recreationists seeking to experience solitude and isolation from human activity. Such changes could also result in displacement or redistribution of recreationists who would choose to avoid such conditions, as well as reduced satisfaction among others who might continue to engage in recreation activities in the area.

4.9.2 Impact Significance Criteria

The following criteria were used to evaluate the potential significance of recreation impacts:

- Levels or patterns of project site development or equipment and vehicle use that would result in displacement of recreation activities from major use areas for more than one season of use, and

- Increased evidence of human activity that would substantially reduce recreationists' perceived levels of isolation and solitude and/or contribute to reduced satisfaction with recreation experiences.

4.9.3 Direct and Indirect Impacts

4.9.3.1 Proposed Action

The major recreation effects from drilling 750 wells at 300 well locations would occur during the pronghorn antelope hunting season, when roughly one thousand hunters are concentrated in the four hunting units that encompass the project area.

The Proposed Action is not expected to significantly alter antelope numbers or their distribution (see Wildlife Section 4.7). Also, demand for antelope licenses in the affected areas greatly exceeds the number of licenses available, and so long as herd conditions remain favorable it is unlikely that the presence of project activities would result in declines in the number of hunters.

However, the combined effects of active drilling, disturbance of other locations by road, pipeline, and drill site construction activities, and high levels of project-related truck traffic would result in a significant alteration to and disruption of the recreation setting. Although the dispersed nature of hunting activity in the project area and the opportunity to move camps and hunting activity to various alternative locations would prevent any major displacement effects involving a complete loss of hunting opportunity, substantial numbers of hunters would likely relocate into other areas within their assigned hunting units. This redistribution of hunters from areas of high project activity into areas of little or no disturbance would contribute to increased levels of hunter crowding in those areas. Because most big game hunters prefer to encounter relatively few other hunters while they are in the field (Krannich and Cundy 1989), this would contribute in turn to reduced levels of hunter satisfaction. Hunters who expect to encounter an isolated environment with little evidence of human activity would also experience reduced satisfaction with a recreation experience that would almost inevitably include some degree of exposure to project-related traffic, noise, dust, and visual effects.

Because a limited number of drilling sites would be active at one time and because the time required for major drilling and construction activities at individual locations would be relatively brief, there would not be significant displacement effects in major use areas lasting longer than one season of use. However, the relatively high levels of project activity associated with this alternative would alter the recreation experiences available to users and cause reduced levels of satisfaction among a significant number of hunters and other recreationists using the area. Such effects would occur at significant levels throughout the several years required to complete all proposed drilling and construction activities, and would not be reduced to insignificant levels by the measures and stipulations incorporated into the action alternatives as described in Chapter 2 and the RMP (USDI-BLM 1990a).

Adverse impacts on recreation resources would be greatest during the initial two-year drilling period, when a majority of the well sites and associated roads and pipelines would be developed. Impacts would continue to occur at somewhat reduced levels during the several subsequent years of drilling and development activity that would follow this initial development period. Even after all drilling activities are completed the presence of production facilities and associated activities would cause the recreation setting to be altered from pre-project conditions. However, recreation impacts would become insignificant at the point when project traffic and other activities are reduced to the very low levels associated with the production phase of the project.

4.9.3.2 Alternative A

Drilling 300 wells at 250 well locations and associated construction and site work would have recreation impacts very similar to those projected to result from the Proposed Action. Because the initial two-year drilling and development schedule would be identical to that anticipated under the Proposed Action, short-term impacts would be significant and identical to those discussed for the Proposed Action. However, the magnitude of impacts would be substantially reduced during the second phase of the drilling program, because after 1996 fifty fewer well sites would be developed and a shorter time frame would be required to complete drilling and construction activity for the substantially smaller number of wells that would be developed.

4.9.3.3 Alternative B

Recreation impacts associated with Alternative B would be indistinguishable from those described for the Proposed Action and Alternative A during the initial two-year drilling and construction period, because the number of well sites developed would remain at 200 and the number of wells drilled would be only slightly lower. Thus, in the short-term there would be significant adverse impacts on recreation opportunities in the project area under all but the No Action alternative. Impacts would decline very substantially after 1996, because under this alternative no additional drilling would occur after initial drilling and development activities are completed.

4.9.3.4 Alternative C - No Action

Implementation of the No Action Alternative would result in the continuation of existing recreation conditions and activity patterns in the GWA II project area. Hunters and other users would continue to experience a recreation setting that has been altered by previous gas field developments and land disturbances. However, these users would not be required to adjust their activity patterns or expectations about recreation conditions and opportunities to the environmental alterations that would occur as a result of additional drilling and development in the area.

4.9.4 Impacts Summary

The Proposed Action as well as Alternatives A and B would have significant adverse impacts on recreation resource conditions and opportunities in the project area, despite the measures outlined in Chapter 2 and the RMP (USDI-BLM 1990a) stipulations. Although user displacement would not occur at significant levels, levels of satisfaction with recreation experiences would be significantly reduced due to the redistribution of recreation use patterns and resultant crowding in some locations and increased exposure to noise, dust, vehicle traffic, and land and visual disturbances associated with project activities. Short-term impacts would be identical for the

Proposed Action and Alternatives A and B during the initial two-year development period. Impacts would persist at reduced but still significant levels over the longer term for the Proposed Action and to a lesser degree for both Alternatives A and B.

4.9.5 Cumulative Impacts

The potential for the proposed project to have significant effects on recreation conditions and opportunities has been increased substantially in the GWA II project area due to the cumulative effects of past energy resource development activities as well as a number of other ongoing or proposed development projects in or near to the project area. Recent gas development associated with the GWA II infill drilling program as well as earlier drilling and development activities within the project area have substantially altered the recreation setting and reduced the availability of areas where recreation activities are not in some way restricted or influenced by the presence of gas production activities. In addition, the existence of several other active or proposed energy resource development projects within or immediately adjacent to the GWA II project area could cause increased disturbance of recreationists using the area. Developments associated with these other projects (i.e., Creston/Blue Gap gas project, Cheyenne Stage I and II pipelines, Uinta Basin Lateral pipeline, Hay Reservoir infill drilling, Mulligan Draw well field development, Sandstone Reservoir, Moxa Arch expansion, Carbon County UCG, and the Kennecott Green Mountain mine) limit the ability of hunters and other recreationists to relocate their activities into other relatively undisturbed areas within or near to the GWA II project area. These conditions increase the potential for users to experience relatively more crowded conditions at available recreation locations than would be the case if the proposed GWA II project was the only major resource development activity in the area. As a result, the cumulative effects of these various projects include a greater potential for recreation displacement, crowding due to user redistribution effects, and increased user dissatisfaction with the recreation conditions that are available in the area.

4.9.6 Mitigation Summary

Although the measures proposed by UPRC (Chapter 2) would help to reduce some adverse effects on recreation resources, additional mitigation measures would be required to effectively address the potential for significant impacts.

Adverse effects associated with drilling and construction activities could be greatly reduced by developing major components of the project in a spatially sequenced manner where possible. User redistribution effects and reductions in recreation satisfaction would drop to reduced levels if major developments occurring at any single point in time were located in a relatively small contiguous area. This would provide greater opportunities for users to select relatively unaffected areas for their recreational activities and reduce the potential for dissatisfaction associated with user crowding or unwanted exposure to project development activities.

4.9.7 Residual Impacts

If all of the measures incorporated into the project and the additional recommended mitigation measures are adopted, reduced but significant residual impacts caused by the presence of production facilities could remain in the recreation setting.

4.10 VISUAL RESOURCES

4.10.1 Introduction

Both short-term and long-term impacts to the visual resource could be possible where patterns of area, line, form, color, and texture in the characteristic landscape would be contrasted by drilling equipment, production facilities, and/or construction related damage to vegetation, topography or other visible site features. The severity of impact depends upon scenic quality, sensitivity level, and distance zone of the affected environment, reclamation potential of the landscape disturbed, and the level of disturbance to the visual resource created by the Proposed Action. In general, impacts would be most severe on sites where mitigation would be difficult and where visual contrasts would be highly visible to potentially large numbers of viewers.

4.10.2 Impact Significance Criteria

A visual impact would be considered significant if the level of contrast produced by the Proposed Action would exceed the level of contrast permitted in a VRM Class and could not be returned to an acceptable level, or where impacts to the visual resource would not comply with the RMP. Combined effects of the action in conjunction with other present actions, proposed future actions, and potential actions permitted under management direction would be considered significant if they create changes in overall character from common natural (common natural/human influence) and the existing condition to human dominated.

4.10.3 Direct and Indirect Impacts

4.10.3.1 Proposed Action

As mentioned in Chapter 3, Affected Environment the GWA II analysis area is not a pristine area; many off-road vehicle tracks have been created by past livestock management practices, recreationist and mineral search and development activities. Under the Proposed Action short-term impacts to the visual resource would include contrasts in line form, color and texture associated with drilling rigs, construction equipment, service trailers, and the general industrial character of drilling operations. Many motorists, tourists in particular, find these contrasts detracting from their appreciation of the landscape, while other motorists may see oil field development as a relief from seemingly endless miles of desert scenery. The Proposed Action would add 1,500 acres (5.0 acres per site) to the 12,527 acres of existing well field related disturbance. This estimated 12 percent increase in disturbed area assumes some use of existing roads. If existing roads are not used, the level of increased contrast would approach an estimated 15 percent. Construction and operation activities also produce fugitive dust which adds to the level of contrast. Drilling site locations that would be visible from I-80, Wyoming Highway 789 and the railroad (potentially as many as 80 in the Class 3 zone) would affect the largest number of viewers. These short-term impacts would exceed the level of contrast permitted in Class 3 areas; however because impacts would be short-term, and no more than 3 drilling rigs would be operating at one time in the most visible areas, they would not be considered significant.

Long-term adverse impacts associated with fixed structures e.g. access roads, pipelines, well heads, and production facilities would remain once drilling activities were completed. Fugitive dust impacts as part of ongoing operations would also continue. Roads and fixed facilities associated with potentially as many as 80 production sites could remain visible from I-80 the railroad and Wyoming Highway 789. Since all 80 sites would be in the foreground/middleground of the I-80 viewshed, these well sites would add to the impact of 22 existing wells in the viewshed. The severity of impact would increase in direct proportion to the number of production facilities located in these viewsheds.

Successful implementation of recommended mitigation measures would reduce contrasts to levels permitted in the Class 3 zone. Impacts would not be considered significant. They would however detract from the experience of motorists (particularly tourists) Amtrak passengers, and backcountry recreationists. If all 80 potential locations in the Class 3 zone in the viewshed described above were developed, the impact would be significant. Successful implementation of recommended mitigation measures would reduce contrasts but not to levels that would be subordinate to the existing landscape as prescribed for Class 3 zones. Development that could exceed class 3 contrast levels and be visible from I-80 and Highway 789 includes production facilities, storage tanks, roads and pipelines. It should be noted that existing development in the Creston quad may already exceed Class 3 level of contrast criteria.

4.10.3.2 Alternative A

Short- and long-term impacts associated with Alternative A would be the same as those described for the Proposed Action but of a slightly reduced magnitude, assuming a proportional reduction of well locations in all viewsheds. The reduction in impact would be most noticeable if most of the 50 fewer well locations in this alternative came from the I-80 viewshed. Depending on site specific conditions and the level of reduction of wells located in the I-80 viewshed, adverse long-term impacts could be reduced to non-significant levels in the Class 3 zone in this alternative.

4.10.3.3 Alternative B

Short- and long-term impacts associated with Alternative B would be the same as those described for the Proposed Action but reduced by 33 percent. As noted for Alternative A above, reductions in the critical I-80 viewsheds would lead to the largest reduction in adverse impacts. Depending on site specific conditions, adverse long-term impacts could be reduced to non significant levels in the Class 3 zone in this alternative.

4.10.3.4 Alternative C - No action

There would continue to be changes to the visual resources under the No Action Alternative. Additional APD and ROW Actions could be granted by the BLM on a case by case basis. Depending on set specific conditions, adverse long-term impacts could remain. However, because the density of well locations would likely be lower than any of the other alternatives, impacts would probably not be considered significant under this alternative.

4.10.4 Impact Summary

Adverse impacts from well construction would occur within the short-term due to contrasts in line, form, color, and texture associated with equipment and surface disturbance juxtaposed with the existing landscape. Long-term impacts would result from production facilities, access roads and fugitive dust. When comparing the four alternatives it was assumed that an equal percentage of well locations would be located in the critical I-80/Wyoming Highway 789 viewshed in each alternative. Impacts would be greatest under the Proposed Action because the largest number of wells are proposed in this alternative. The Proposed Action and Alternative A could produce significant impacts if all potential well locations in the Class 3 zone, I-80/Wyoming Highway 789 viewshed were developed. Impacts for Alternatives B and C would not be considered significant, but would detract from the experience of motorists, Amtrak passengers and backcountry recreationists.

4.10.5 Cumulative Impacts

To date 217 wells and an additional 70^{+} have been drilled in the GWA II analysis area. The Proposed Action would add substantially to the existing level of impact as described (by more than doubling the number of well locations). Depending upon specific siting conditions; the Proposed Action could tip the level of contrast scale to Human Dominated in the I-80 viewshed. Other proposed actions in the vicinity include Hay Reservoir infill drilling, Uintah Basin Lateral pipeline and Mulligan Draw well field development. All three are in remote locations and do not share a common viewshed with the GWA II analysis area. Consequently completion of these three proposed actions together with the GWA II analysis area would not have a cumulative effect on the visual resource.

4.10.6 Residual Impacts

Impacts including potentially significant impacts within the I-80 viewshed would persist for the life of the project. Once activities are terminated, compliance with recommended cleanup and reclamation procedures would bring the area into compliance with Class 3 zone permitted levels of contrast. Class 4 areas would remain in compliance with high levels of permitted contrasts.

4.11 CULTURAL RESOURCES

4.11.1 Introduction

Cultural resources on public land, including archaeological sites and historic properties, are protected by various laws and regulations. The National Historic Preservation Act of 1966 (NHPA) and 36 CFR 800 are two examples of particular pertinence. The specific directives can be found in Archeology and Historic Preservation: Secretary of the Interior's Standards and Guidelines (USDI-BLM 1983b). Laws and regulations concerning cultural resources stipulate that a proposed undertaking must take into consideration the effects of the action on significant cultural resources. This requires that cultural resources within the proposed area of potential effect (APE) be identified and evaluated. Measures can then be taken to mitigate or minimize the adverse effects to those resources that are considered to be significant.

The GWA II cultural resource database includes at least 1935 sites, consisting of both prehistoric and historic components. Prehistoric sites in the study area are predominantly open camps, lithic scatters, and features not associated with portable cultural material. Of the total 1808 prehistoric sites, 643 are considered eligible for the National Register, 747 are not eligible, and 418 are unevaluated. Within the study area 35.6 percent of the prehistoric sites are eligible properties, 41.3 percent are not eligible, and unevaluated sites represent another 23.1 percent of the sites recorded. The high percentage of eligible and unevaluated sites is in part a reflection of the limited amount of detailed excavation in the study area, which could be used to develop more specific significance criteria.

Historic site types within the study area include historic trails, stage stations, railroad grades and stations, townsites, ranches, and cabins. Of the 127 historic sites, 32 have been evaluated as being eligible for the National Register, 58 are not eligible, and 37 sites have been left unevaluated. Within the study area 25.2 percent of the historic sites are considered eligible properties, 46.7 percent are not eligible, and 29.1 percent of the sites are unevaluated.

4.11.1.1 Native American Consultation

The Wyoming Bureau of Land Management, Rawlins District, has conducted the Native American consultation in accordance with Section 4(c) of the Archaeological Resources Protection Act (16 U.S.C.470cc) and Section 43 CFR 7.7.(b)(1). Native American cultural groups that may have a historical interest in the area were contacted to convey to the BLM any questions and/or concerns they may have within the GWA II analysis area. The BLM has not received any correspondence from the cultural groups involved.

4.11.2 Impact Significance Criteria

4.11.2.1 Assessment of Site Significance

Mitigation of adverse effects is afforded to properties eligible for nomination to, or actually listed on the National Register of Historic Places. Site significance, and therefore National Register eligibility, is measured by eligibility requirements established by the National Register. The National Register (36 CFR 60.4) measures historical significance as "the quality of significance in American history, architecture, archeology, and culture present in districts, sites, buildings, structures and objects of state and local importance that possess integrity of location, design, setting, materials, workmanship, feeling, and association. The National Register defines four categories with which to measure that significance. These criteria include sites/structures that:

- are associated with events that have made a significant contribution to the broad patterns of our history (Criterion A); or

- are associated with the lives of persons significant in our past (Criterion B); or

- embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; (Criterion C); or

- have yielded, or may be likely to yield information important in prehistory or history (Criterion D).

For both prehistoric and historic archaeological sites, significance is primarily judged by a site's potential to yield information important in prehistory or history, i.e., significance is based on information content and how that information will contribute to addressing local and regional research questions or problems.

The Advisory Council on Historic Preservation has developed guidelines for determining adverse impacts for sites on or eligible to the National Register [36 CFR 800.9 (b)(1),(2),(3)]. Significant impacts to cultural resources consist of the following:

- Destruction or alteration of all or part of a property.

- Isolation of a cultural resource from, or alteration of, its surrounding environment.

- Introduction of visual, audible, or atmospheric elements that are out of character with the property or alter its setting.

- Neglect and subsequent deterioration.

4.11.3 Direct and Indirect Impacts

4.11.3.1 Alternative A

Adverse effects to cultural resources under Alternative A could be in the form of direct, indirect, or cumulative impacts. Potential direct impacts to the sites considered eligible for the National Register of Historic Places (NRHP) would primarily result from construction-related activities. Impacts would be significant if any information were lost that impeded efforts to reconstruct the prehistory or history of the region. Activities that are considered to have the greatest effect on cultural resources include the blading of well pad and associated facilities, construction of roads, and product transportation facilities. Sites that are located outside the APE will not be directly affected by construction-related activity. Additionally, if the portion of a site crossed by earth-disturbing activity does not possess the qualities that make the site eligible, the project may be judged to have no effect on the site. Mitigative data recovery would occur at eligible sites located within the APE and scheduled for disturbance. This mitigation usually would occur prior to the disturbance.

Indirect impacts would not immediately result in the physical alteration of the property. Indirect impacts to prehistoric sites primarily include unauthorized surface collecting of artifacts which physically alters the site assemblage. With regard to historic sites, indirect impacts would result from surface artifact collecting and alteration of the surrounding environment by introducing visual impacts. These effects could be considered cumulative if they persisted through time and resulted in incremental deterioration of a property.

4.11.3.2 Alternative B

Impacts associated with Alternative B would be similar, but of potentially smaller magnitude, than those described for Alternative A.

4.11.3.3 Alternative C - No Action

Under the No Action Alternative, no effects or increase in potential for impacts to cultural resources within the GWA II analysis area would occur. However, the potential for impacts would continue as drill sites are completed within the area.

4.11.4 Impacts Summary

Gaging the effect of any impact on a specific cultural property depends on the level of information available for that particular property provided by inventory and/or testing data. If cultural resources that are on or are eligible for the National Register under Criterion D are to be adversely impacted by a proposed undertaking, then the applicant, in consultation with the surface-managing agency and State Historic Preservation Office (SHPO), shall develop a mitigation plan. Typically, construction does not proceed until terms of the mitigation plan are satisfied.

Potential impacts to specific eligible or unevaluated properties are unknown at this time. Given that the majority of the proposed well sites and associated access roads and pipelines would be in the Echo Springs field, the C.G. Road Unit, the Tierney Unit, and the Two Rim Unit, areas with high to moderate site density, development would likely encounter significant cultural resources. These areas have been the subject of large block inventories which have demonstrated extremely high site densities of greater than 30 sites/section. Randomly situated well locations would have a high probability of encountering known cultural resources and approximately half the sites encountered would be eligible for the Register. The site density in the areas that has not been subject to 100 percent inventory range from a low of roughly one site/section to as high as 50 sites/section.

Sites would be impacted if project personnel collect artifacts from the sites. These impacts can be alleviated by educating personnel about the importance of cultural resources and the consequences of unauthorized collection of cultural material.

In general, the study area has a moderate to high site density, and therefore, high archaeological sensitivity. Certain geomorphic situations have a greater archaeological potential than other areas especially in terms of significant cultural resources. These situations include eolian deposits (sand dunes, sand shadows and sand sheets), alluvial deposits along major drainages, and colluvial deposits along the low slopes of Delaney Rim. Construction monitoring and open-trench inspection can be used to identify cultural resources that lack a surface manifestation.

Although the GWA II analysis area has a high degree of archaeological sensitivity, impacts to cultural properties would not be significant. Potential impacts to known and anticipated cultural resources can be alleviated through appropriate mitigation measures.

4.11.5 Cumulative Impacts

Disturbance and/or loss of other unidentified sites or artifacts could add to the cumulative loss of information about our heritage in the analysis area and in the region if these sites or resources are not identified and inventoried prior to disturbance. Any loss or damage to unidentified cultural or historical sites or resources associated with the proposed natural gas development project, combined with similar losses or damage due to natural gas development projects near the GWA II analysis area, could be substantial. The implementation of Class III pedestrian inventory on all proposed drill sites, access roads, and pipeline corridors would minimize the potential for cumulative impacts to cultural resources in the analysis area.

4.11.6 Mitigation Summary

If a site is considered eligible for nomination to, or is on the National Register, and if that site will be impacted, then mitigative procedures must be implemented. Avoidance is the preferred method for the mitigation of adverse effects to an eligible property. Avoidance is accomplished through project redesign to totally eliminate or minimize impacts. The total avoidance of significant cultural resources is not always possible or prudent given other management considerations. The total avoidance of some properties, (e.g., historic trails), may not be considered the preferred option if the avoidance would lead to greater overall land disturbance or would result in significant impacts to other resources such as wildlife, hydrology, soil, or range. Mitigation of adverse effects to properties that cannot be avoided would be accomplished by the documentation of the physical remains. For historic sites consisting of standing structures this could include detailed drawings and photographs following regulatory standards. For archaeological properties the documentation of physical remains would consist of data recovery.

If at any time during construction cultural resources are found, all construction activities will halt and the appropriate BLM personnel will be notified. Work will not proceed until the cultural materials are handled properly by qualified archaeologists and notification is received from the BLM.

4.11.7 Residual Impacts

By avoiding known cultural and historical sites during drilling facility layout (drill sites, access roads, and pipeline corridors), and by implementing Class III inventory on the proposed project elements (drill sites, access roads, and pipeline corridors) the potential for adverse impacts to cultural resources in the analysis area is minimized. With implementation of these measures, there would be no avoidable impacts to cultural resources in the analysis area.

4.12 SOCIOECONOMICS

4.12.1 Introduction

Potential social and economic effects of petroleum development activities include increases in area employment and economic activity, population growth effects in surrounding communities, increased demands for public and private services and housing, changing revenue and expenditure patterns for counties and communities, and shifts in community social structures and the attitudes and perceptions of area residents (Little and Krannich 1989, Weber and Howell 1982). In situations where project-related population growth greatly exceeds the adaptive capacity of local service infrastructure or community social organization, a variety of social disruptions such as increased crime rates, substance abuse problems, family disturbances, and mental health effects may occur (Krannich and Cramer 1993).

4.12.2 Impact Significance Criteria

The following criteria are used to determine whether socioeconomic impacts of the proposed project would be significant:

- demographic impacts projected to involve a greater than 10 percent annual increase in a local community population lasting for a period of more than one year. This criteria is based on the assumption that such growth would strain the ability of affected communities to provide housing and services or otherwise adapt to growth-related social and economic changes;

- an aggregate change in revenue flows and expenditures that would likely result in an inability on the part of affected units of government to maintain public services and facilities at established service level standards;

- any permanent displacement of residents or users of affected areas that would result due to major project-induced changes in or conflicts with existing ways of life; and

- levels of project-induced dissatisfaction among area residents that would be likely to generate organizational response and conflict.

4.12.3 Direct and Indirect Impacts

4.12.3.1 Proposed Action

Data provided by UPRC on personnel requirements for the proposed drilling and field development activities suggest that during the drilling phase of the project approximately 25 workers would be required per active rig, including persons involved directly in the drilling activity and those involved in road and location construction (see Table 2-6). Because no more than eight rigs would be in operation at one time during the 1994-96 period of highest drilling activity, the peak work force required for drilling activities would be approximately 200 drill rig workers. Additional workers would be required for well completion and testing and to construct pipelines and production facilities that would be developed while drilling activities are still in progress. Depending on the timing of such additional developments, as many as 100 additional workers may be required at one time. The total peak work force would therefore be approximately 300 persons. These estimates are consistent with employment estimates obtained from the U.S. Forest Service IMPLAN model. Employment in the following years will decline to approximately 100 employees the second year and approximately 75 in the following ten years of drilling.

The project area is located within long-distance commuting range of both Rawlins and Rock Springs. It is unlikely that a majority of project workers would be current residents of either Carbon or Sweetwater counties. Declines in petroleum development activity during the mid-1980s resulted in a substantial migration of oil/natural gas field workers out of southern Wyoming, reducing the number of potential project employees in the regional labor force. More recently, substantial increases in petroleum exploration and other types of resource development in and around the project area have created increased labor demand for drilling crews and construction workers, further reducing the availability of local area workers qualified for employment on the proposed GWA II project.

Based on previous petroleum development experiences in southwestern Wyoming, approximately 50-55 percent of the project workforce, or 150-160 workers at the point of peak employment, would temporarily relocate to communities within commuting distance of the project area during the peak of drilling and construction activity (see Planning Information Corporation 1986, 1994). Due to the short-term nature of some project-related employment and the socio-demographic characteristics of oil/natural gas field workers, many of the in-migrating workers would be single-status (e.g., not accompanied by family members). Based on experiences at other resource development projects in southern Wyoming, it is anticipated that approximately 45 percent of in-migrating workers would be accompanied by family members, and that the average household size for these workers would be 2.6 persons (see Planning Information Corporation 1994). These data suggest a change in population of about 275 during the maximum drilling period. The IMPLAN model projected a total population change of about 600; however, these data do not reflect the transient nature of the drilling phase workforce.

Based on these figures, the total regional population increase resulting from immigration of project workers and members of their households would be approximately 275 to 350 persons at the peak of drilling activity. Indirect employment opportunities associated with project-related expenditures for goods and services would potentially cause only very limited additional population growth effects, because much of the increased demand would be absorbed by existing operations and because some indirect employment opportunities would be filled by persons already in the labor force or by household members accompanying relocating project workers. The extent to which this population increase would persist beyond the initial 1994-96 drilling period is uncertain, because the drilling schedule through the year 2005 would depend on a variety of unknown factors such as the price of natural gas. Most project workers would likely move away from the area following the completion of drilling activities, unless there were alternative employment opportunities associated with other resource development activities in the area. For the projected drilling of approximately 55 wells per year for ten years, a longer-term population change of about 250 persons (including direct, indirect, and induced employment) as estimated by the IMPLAN model.

IMPLAN was used to project employment and population in the two-county region. Value of production was assumed to be $1.75 per million cubic feet (MMCF), which is about the average of wellhead price over the past several years, and falls within the historical range of $1.20 to $2.10 per MMCF. In addition, UPRC estimates that approximately one-third of the wells will deliver full production (beginning with 1.5 million cu.ft/day, declining to 500,000 cu.ft/day by the fifth year, to 200,000 cu.ft/day by the tenth year and maintaining about 100,000 to 150,000 cu.ft/day for the remainder of the 20-year period). The remaining 2/3 of the wells will likely deliver between 40 and 50 percent of full production (Donleavy 1994), and 45 percent was used as the estimated production. During well production, the IMPLAN model projects a fairly stable employment and population increase over the first 12 years because the model is driven by the value of gas produced rather than the number of wells. The projected employment is approximately 234 direct employees and 401 persons direct population increase, and a total of 314 direct jobs and 538 population. After the first 12 years, the value of production declines with well output, and the IMPLAN model thus projects reduced employment and population of 127 and 171 direct and 219 and 293 total effects approximately 15 years after drilling begins. At the end of the 20-year period total production-related and total employment and population are projected to be 76 and 130 and 102 and 176, respectively.

Table 4-10 indicates the aggregated (direct, indirect and induced) changes in total sales, various measures of income, employment and population for this alternative for the production of gas. *Final Demand* indicates the value of gas exported; *TIO* indicates the total gross sales in the two-county region; *Employee Compensation* Income represents all wage and salary payments; *Property Income* represents payments to owned private property (proprietor's income); *Total POW Income* is the sum of payments to households (the sum of wages, salaries and property income); *Value Added* is the measure of total returns to capital and labor in the local economy; and *Employment* is the number of jobs created.

Table 4-10. Economic Effects of Gas Production with the Proposed Action.

Economic Category	Initial 12 Years (TOTAL)	At 15 Years (TOTAL)	At 20 Years (TOTAL)
Total Value Added (MM$)	88.5932	48.3235	28.9916
Employment Industry (No. of Jobs)	91.2181	49.7554	29.8504
Final Demand (MM$)	10.8500	5.9182	3.5502
TIO (MM$)	16.9421	9.2412	5.5440
Employee Comp. Income (MM$)	27.7922	15.1594	9.0942
Property Income (MM$)	33.1925	18.1050	10.8612
Total POW Income (MM$)	314.1400	171.3500	102.7500
Change in Population	538	293	176

Although the projected level of population growth is inconsequential in the context of the total populations of either Carbon or Sweetwater counties, there is a potential for some adverse growth-related socioeconomic effects in specific locations. A substantial portion of the project-induced in-migration would flow to Rawlins and Rock Springs, due to the larger size of these cities and the greater access to facilities and services there. In either case, the level of in-migration would be substantially below the 10 percent net population growth threshold that has been established for identifying significant impacts. However, the current shortage of rental homes and apartments in Rawlins and Rock Springs would make housing access difficult for those who do not either purchase a mobile home or RV or bring one with them. In addition, the movement of even modest numbers of relocating project workers to Rock Springs would add to existing pressures on local medical services and the municipal water supply system.

To the extent that housing could be acquired, a majority of relocating project workers would likely choose to live in Wamsutter due to its proximity to the project area. The location of even 50 percent of in-migrating workers in Wamsutter would fill virtually all mobile home spaces in the town. Wamsutter would experience population growth substantially in excess of the 10 percent level generally considered to represent a threshold for successful community adaptation.

Although information provided by town officials and several community residents suggests that the town is capable of absorbing a modest additional amount of population growth, project-induced in-migration would nevertheless temporarily strain the ability of Wamsutter and Sweetwater County to provide adequate levels of services. Demands placed on public utilities, health and safety services, law enforcement, and public schools in the Wamsutter area would require significant increases in expenditures for personnel, equipment, and operating budgets. Such effects would be greatest during the initial 1994-96 drilling period, because the level of population growth would be highest during this period and because of a lag in the availability of project-related revenues to support service expansions. Impacts would drop to insignificant levels after the first two to three years of the project, as population growth effects would stabilize through approximately the year 2006 and revenues associated with the project would be available to help support increased service demands.

Estimates of project costs and taxes associated with this level of drilling and development suggest that the aggregate economic effects would be substantial and positive over the long term. Estimated total costs for well development activities are $863,000 per well, with pipeline components of the project totaling an additional $60,000 per well in project costs. Many expenditures for equipment and materials would likely occur outside of the local area, and only a portion of the labor expenditures would involve local area workers whose incomes would circulate within the local economy. Nevertheless, implementation of this alternative would generate substantial revenues for the state, counties, and local governments as well as area school districts.

Payments of severance taxes, ad valorem taxes and royalty payments were estimated as a total of $244,000, $296,000 and $525,000, respectively, per well (USDI-BLM 1992a) in the initial GWA Environmental Assessment. These data were based on the various tax rates applied by the State of Wyoming and the Federal Government, and were based on the $1.75 per MMCF. average wellhead price. It should be noted that these payments are an undiscounted aggregate and that the annual payments will decline as production in the well declines. The projected declining production for wells suggests that these payments will be higher in the early years (approximately $62,000 severance tax per full-delivery well in the first year, declining to $8,000 by the 10th and to about $6,000 by the 20th year, and about 40 to 50 percent of those payments for marginal wells). Clearly, the tax revenues to the State and counties depends upon the wellhead price, which has historically been somewhat unstable. However, the timing of these beneficial economic effects would not coincide with the timing of increased costs associated with the need to temporarily increase levels of public services. As a result, there would be some very short-term negative economic consequences for affected units of government, which would primarily impact Sweetwater County because it provides services to residents of Wamsutter. On balance, these negative effects would be relatively minor due to the short-term nature of project-related population growth and because such effects would be substantially outweighed over the longer term by substantial positive economic flows.

The potential for a temporary population boom in Wamsutter is an issue of concern to some town and county officials as well as some area residents, many of whom remember the problems of widespread social disruption that occurred during the boom periods of the late 1970s and early 1980s. A number of area residents and officials indicate that they would prefer to see a slower pace of development that would have more modest growth effects. At the same time, there is considerable support for developments that promise sustained employment opportunities and other economic benefits. Since the development of this project would generate a sharp but temporary growth effect followed by a longer period of fairly stable activity, it is not likely to be a source of widespread dissatisfaction. Also, it is not expected that the project would significantly alter local lifestyles or displace any individuals from their current economic activities. Residents of this area are accustomed to and generally accepting of petroleum developments, and those contacted in the course of this assessment were supportive of the proposed GWA II development. In many cases, area residents and community leaders are anxious for new developments that may help restore some of the economic opportunities and local government fiscal resources that were eroded during much of the past decade as a result of declining energy exploration and production. Overall, most area residents are likely to view this proposed development favorably, particularly since it would help to sustain employment opportunities, local business activity, and revenues to support public services in an area where substantial previous drilling and development activities have occurred.

Despite this overall context of community acceptance, some population segments could potentially experience some negative effects as a result of project activities. As was discussed in the analysis of recreation impacts, some negative responses would likely be evident among hunters as a result of deterioration in the quality of hunting experiences available in the project area. In addition, ranchers may have their operations and daily activity patterns within the project area disrupted by drilling and other project activities (Bennett 1987). Among the concerns identified by ranchers operating in the GWA II project area are increased livestock loss from collisions with project-related vehicle traffic, potential disruption to operations in areas of highly concentrated project activity, and problems associated with weed growth in disturbed soils. At the same time, livestock operators are likely to experience some beneficial effects due to increased access into grazing areas via project roads and increased livestock watering capabilities from project-related wells.

4.12.3.2 Alternative A

Socioeconomic impacts that would occur under Alternative A would be similar to those projected for the Proposed Action for the first three years of the drilling period. Project employment, population growth effects, and associated increases in demands for housing and public services would be identical to those projected for the Proposed Action during the initial (1994-96) drilling period, with significant impacts occurring in the town of Wamsutter. After 1996 both positive and negative socioeconomic effects would be substantially lower than would occur under the Proposed Action due to a substantially reduced level of drilling activity and a smaller number of wells placed into production under this alternative. Production-related employment and population are estimated to be the same as for the proposed alternative by the IMPLAN model. However, it should be noted that long-term production employment would decline rapidly as a result of the production pattern in the wells. It is likely that a lower total population effect would occur, since well-field workers could not anticipate long-term employment. By the end of the fifth year, direct employment and population would be reduced to about 170 and 292, respectively, with total employment and population estimated by IMPLAN at 230 and 391, respectively. By the 10th year those employment and population levels would stabilize at 51 and 88 direct, respectively and 68 and 117 total, respectively. Table 4-11 indicates the total impacts of gas production for Alternative A on total sales, income, and employment. As a result, adverse impacts associated with population growth and demand for housing and services would become insignificant after about 1996.

Table 4-11. Economic Effects of Gas Production with Alternative A.

Economic Category	Initial 12 Years (TOTAL)	At 15 Years (TOTAL)	At 20 Years (TOTAL)
Total Value Added (MM$)	88.5932	64.4314	19.3278
Employment Industry (No. of Jobs)	91.2181	66.3405	19.9003
Final Demand (MM$)	10.8500	7.8909	2.3668
TIO (MM$)	16.9421	12.3216	3.6960
Employee Comp. Income (MM$)	27.7922	20.2125	6.0628
Property Income (MM$)	33.1925	24.1400	7.2408
Total POW Income (MM$)	314.1400	228.4600	68.5050
Change in Population	538	391	117

Payments to State and County governments would follow a similar pattern; initial payments would be approximately the same as for the proposed alternative, but would drop rapidly. These payments would follow the same per-well payments as in the proposed alternative, but the total payments would fall rapidly to a relatively stable amount by the 10th year of production, because no new wells would be added after the initial three years of drilling.

4.12.3.3 Alternative B

Socioeconomic impacts associated with Alternative B would be indistinguishable from those described for the Proposed Action and Alternative A during the initial 1994-96 drilling and construction period. In this time period there would be significant adverse effects associated with population growth and infrastructure shortfalls in the town of Wamsutter. Impacts would decline to insignificant levels by 1996, because no additional drilling would occur after the initial drilling and development activities.

Employment and population during the production period would not differ substantially from Alternative A, although somewhat fewer employees would be needed in the longer run with a resulting smaller change in population (direct effects of 29 employees and 50 population by year 10 and 40, and 68 total cumulative effects). Again, severance and ad valorem taxes and royalty payments would be approximately the same for each well, but the fewer number of wells would mean reduced total revenues to State and County governments. The pattern of rapidly declining per well and total payments would occur because no new wells would be added after the initial two years of drilling. Table 4-12 indicates the total impacts on total sales, income, and employment resulting from Alternative B. Note that the values from Alternative A are used for the initial three years and also at eight years. The analysis indicated insignificant difference between the values presented.

4.12.3.4 Alternative C - No Action

Implementation of the No Action Alternative would continue the existing socioeconomic conditions and trends in the communities located in and around the project area. Because other petroleum and resource development activities are ongoing or proposed in this area of Wyoming, these trends would likely involve some increased employment levels and population growth, at least in the near term. Over the longer term, the cyclical nature of energy resource development makes it likely that area communities would continue to experience unstable economic and demographic conditions. A decision to not pursue development in the GWA II analysis area would likely generate disappointment and dissatisfaction among many area residents and community leaders who are generally supportive of expanded resource developments and the expanded economic and employment opportunities associated with such projects.

Table 4-12. Economic Effects of Gas Production with Alternative B.

Economic Category	Initial 12 Years (TOTAL)	At 15 Years (TOTAL)	At 20 Years (TOTAL)
Total Value Added (MM$)	88.5932	19.3278	11.2745
Employment Industry (No. of Jobs)	91.2181	19.9003	11.6085
Final Demand (MM$)	10.8500	2.3668	1.3806
TIO (MM$)	16.9421	3.6961	2.1560
Employee Comp. Income (MM$)	27.7922	6.0628	3.5366
Property Income (MM$)	33.1925	7.2408	4.2238
Total POW Income (MM$)	314.14	68.5000	39.9600
Change in Population	538	117	68

4.12.4 Impacts Summary

Neither the Proposed Action nor any of the alternatives would stimulate extremely rapid growth and associated adverse socioeconomic impacts such as were previously experienced in the area during the energy boom period of the 1970s (Gilmore and Duff 1975). Nevertheless, potentially adverse effects may occur, particularly in the town of Wamsutter where population increases resulting under the Proposed Action could cause short-term difficulties involving housing supply, public service provision, and general adjustment problems associated with rapid social and economic change. However, the availability of housing and services in Rawlins and other areas within commuting distance of the project area would help to reduce the potential for excessive growth pressures in Wamsutter. Alternative A would have these same impacts during the initial 1994-96 project phase, with much-reduced impacts thereafter depending on the pace of project development. Alternative B would have the same effects during the initial 1994-96 drilling and construction period, but would have only limited effects thereafter. None of the action alternatives is likely to generate widespread dissatisfaction or organized opposition among area residents.

4.12.5 Cumulative Impacts

The potential for serious adverse socioeconomic impacts associated with the proposed GWA II development has been increased substantially due to the cumulative effects of numerous other development activities that are proposed or scheduled in the surrounding area. As noted in Chapter 2, there are a number of other resource development and construction projects in Sweetwater and Carbon counties that will be pursued during the same time period as that proposed for the GWA II drilling and construction program; these other projects will require workforces with similar skills and experience. Some other projects that are already underway are causing problematic growth pressures in the Rock Springs area (Planning Information Corporation 1994), and increased resource development activities have contributed to a shortage of housing throughout the analysis area.

The cumulative population growth effects of the several projects that are likely to occur simultaneously in the area will tend to be considerably greater than if only one project were scheduled. Because several of the other ongoing and proposed projects are centered around Wamsutter, the levels of worker in-migration and associated increased demands for housing and public services in that community could potentially be very substantial. In addition, the reappearance of major boom growth problems in the area could result in significant social disruption effects that would otherwise not be anticipated if only the GWA II project was active in the area.

4.12.6 Mitigation Summary

In addition to the measures outlined in Chapter 2 and in the RMP, efforts to accommodate worker housing needs would be necessary to address the potentially significant socioeconomic impacts associated with this project and other projects in the vicinity. GWA II operators should implement a socioeconomic monitoring program that would track area housing availability, the number of relocating workers, and the residential locations of workers. Information on housing availability should be made available to relocating workers to assist them in their search for suitable housing. In the event that available housing supplies cannot meet worker demand, GWA II operators should work toward developing a worker housing mitigation plan that identifies other housing facilities and aids in locating temporary employee housing in the Wamsutter area.

4.12.7 Residual Impacts

Although the proposed project would temporarily stress community services, housing supply, and social structures in Wamsutter and to a lesser extent in other more distant regional communities, most of the anticipated effects would be of relatively short duration. The relatively short-term nature of major project activities would limit the extent of adverse impacts. In addition, incorporation of recommended mitigation measures would reduce potentially adverse socioeconomic impacts to non-significant levels.

4.13 TRANSPORTATION

4.13.1 Introduction

Transportation effects of the Proposed Action and alternatives would occur primarily on US Interstate 80 (I-80), Wyoming Highway 789 (WY 789), and Sweetwater County Road 4-23. These highways provide access from nearby communities to the analysis area. Secondary transportation effects would also occur on operator-maintained roads within the GWA II analysis area.

4.13.2 Impact Significance Criteria

The following criteria were used to determine whether transportation impacts of the Proposed Action and alternatives would be significant:

- Increases in traffic levels on the local public highway network that would cause the level of service on large segments of those public highways to fall below acceptable levels as defined by the responsible government agency.

- Measurable increases in accident rates on the local public highway network above the average accident rate for similar roadways which would increase the risk to highway users.

4.13.3 Direct and Indirect Impacts

4.13.3.1 Proposed Action

The Proposed Action would allow GWA II operators to drill and develop 750 wells with 300 locations in the GWA II analysis area in addition to existing operations. The Proposed Action would generate increases in traffic volumes on highways leading to the analysis area and on County and operator maintained roads within the GWA II analysis area. These increases would result from the movement of workers, equipment and materials to and from the analysis area to perform drilling, field development, well service, field operations and reclamation activities. Additionally, in order to perform the wellfield development activities associated with the Proposed Action, new access roads would be required. GWA II operators assumed that a total of 150 miles of access road associated with the Proposed Action. This would result in a total of approximately 0.5 miles of new access roads per well associated with the Proposed Action.

Proposed Action-related increases in traffic volumes are anticipated to be insignificant relative to existing capacity on highways within the GWA II analysis area. The greatest increases would occur on I-80 and WY 789.

It is unlikely that the relatively low increase in traffic volumes on highways within the analysis area would result in a measurable increase in accident rates, given that these highways currently accommodate substantial wellfield development and operations-related traffic and the Proposed Action-related increases are not anticipated to result in a decrease of level of service for these highways.

County and operator-maintained roads internal to the analysis area primarily service wellfield development and operations-related traffic. Proposed Action-related activities would result in a substantial number of additional trips on internal roads. This additional volume of traffic is not anticipated to negatively affect levels of service or accident rates on internal roads. However, demand for road maintenance would increase substantially on certain heavily travelled internal roads.

Given that traffic increases associated with the Proposed Action are not anticipated to result in a decrease in the levels of service of any highway and that accidents rates are not anticipated to increase, the transportation impacts of the Proposed Action would be below the significance threshold established for this analysis.

4.13.3.2 Alternative A

Alternative A involves the development of 300 wells with 250 well locations within the GWA II analysis area in addition to existing operations. Implementation of Alternative A would result in transportation impacts less than those described for the Proposed Action, since fewer wells would be developed. Increase in traffic associated with Alternative A would not be significant under the thresholds established for this analysis.

4.13.3.3 Alternative B

Alternative B provides for the minimum development of 225 wells with 200 locations within the GWA II analysis area in addition to existing operations. Increase in traffic associated with Alternative B would not be significant under the thresholds established for this analysis.

4.13.3.4 Alternative C - No Action

The no-action alternative would result in transportation conditions similar to those described in Chapter 3 (Section 3.13). Current traffic levels on the highways within the analysis area would decline under this alternative because well drilling and field development-related traffic would decrease.

4.13.4 Impacts Summary

The increases in traffic associated with the Proposed Action and Alternatives A and B would create direct impacts when compared to the No Action alternative. These impacts would occur throughout the life of the drilling program. Due to the good condition and excess capacity of the highways within the analysis area, these impacts are not considered significant.

4.13.5 Cumulative Impacts

Other major industrial development is anticipated to occur near the GWA II analysis area. A major natural gas development project is planned on the east side of the GWA II analysis area (Creston/Blue Gap Natural Gas Project). This project involves drilling and development of 200 to 330 natural gas wells on approximately 207,746 acres. Total life of the project is anticipated to be 30 to 50 years. Wyoming 789 and I-80 would be the primary means of access to the analysis area. Additionally, natural gas drilling and development is planned in the Mulligan Draw Area, located adjacent to the south side of the GWA II analysis area. This development calls for drilling approximately 45 total wells on 640 acre spacing over a period of several years. The main access to this area would be I-80, WY 789, and local county roads. Construction and operations-related traffic associated with these facilities would create cumulative effects primarily on I-80, WY 789, and Sweetwater County Road 4-23. Given that these roads are designed and maintained to withstand heavy traffic, deteriorations in levels of service are not anticipated from these cumulative impacts.

Currently, the lands adjacent to the analysis area are anticipated to experience substantial petroleum exploration and development activity over the next several years. Since the major highways providing access to the GWA II analysis area also provide access to other fields in the area, it is likely that other oil and gas drilling projects would generate cumulative transportation impacts for these major highways (I-80, WY 789). Projections of increases in traffic volumes are not available for other planned exploration and development activities. However, given that the planned exploration and development activities are all planned over several years, it is unlikely that cumulative oil and gas activities will result in cumulative impacts that would exceed the significance criteria established for this analysis.

4.13.6 Mitigation Summary

Road development and on-going maintenance could be minimized by the development of an area-wide transportation plan for road development and maintenance within the analysis area. The transportation plan should identify the minimum road network that would be required to support the drilling plans of each operator. Existing roads should be used as collectors and local roads whenever possible to minimize new surface disturbance within the area. Standards for road design should be consistent with BLM Road Standards Manual Section 9113. The transportation plan should also address the issue of road maintenance agreements between the operators.

Permits are required from the appropriate county for access to or across a county road or for pipeline crossings of a county road. These permits should be acquired prior to construction of additional roads. All roads on public lands which are not required for operation and maintenance of field production should be permanently blocked, re-contoured and reseeded. Roads on private lands should be treated similarly depending on the desires of the land owner.

The operators of the field will be responsible for preventive and corrective maintenance of roads in the analysis area throughout the duration of the project. This may include blading, cleaning ditches and drainage facilities, dust abatement, noxious weed control, or other requirements as directed by the BLM.

4.13.7 Residual Impacts

Increases in traffic associated with production, well and pipeline service, and reclamation activities would continue throughout the life of the project.

4.14 HEALTH AND SAFETY

4.14.1 Introduction

Potential risks associated with the Proposed Action include the normal risks associated with traffic, heavy construction and drilling operations. As described in Air Quality, H_2S is not present within the GWA II analysis area, and therefore, is not a safety concern for this area.

4.14.2 Impact Significance Criteria

No specific health and safety standards were identified in the Great Divide Resource Area RMP. The following criteria were used to determine the degree of impacts relative to health and safety aspects of the natural gas production proposal:

- Increased risk to the public caused by project implementation.

4.14.3 Direct and Indirect Impacts

4.14.3.1 Proposed Action

During 1992, the oil and gas industry in Wyoming experienced an overall incidence rate of 8.3 injuries and illnesses per 100 workers (U.S. Department of Labor, Bureau of Labor Statistics 1994). During 1992, a total of 12,100 workdays were lost in the oil and gas extraction industry. Of this total, 2,600 days were lost in the area of crude petroleum and natural gas production, with the remaining 9,500 lost workdays occurring in the oil and gas field services area. Injury and illness lost workdays occurring in the oil and gas extraction industry were almost twice the rate of similar fields in the mining industry. These potential risks associated with the oil and gas extraction industry would be limited to employees and subcontractors and would not affect the public.

Short-term health and safety impacts could occur during the maintenance and construction of the road system, with possibly some effect on the existing public traffic. The increase in traffic volume would have a tendency to increase accidents during construction and drilling operations. With completion of the initial phases of the drilling and production operations, there would be minimal long-term health and safety impacts other than those associated with service vehicles providing support and maintenance operations.

4.14.3.2 Alternative A

Impacts from road, drill site, and pipeline construction; drilling operations; production operations; and project traffic would be similar to those described under the Proposed Action, with the exception of fewer hazards imposed by a smaller drilling and production operation.

4.14.3.3 Alternative B

Impacts from road, drill site, and pipeline construction; drilling operations; production operations; and project traffic would be similar to those described under the Alternative A with the exception of fewer hazards imposed by somewhat smaller drilling and production operations.

4.14.3.4 Alternative C - No Action

Health and safety issues within the GWA II analysis area would remain essentially as described in the Affected Environment although additional well development would occur as APDs were approved by the BLM on a case-by-case basis.

4.14.4 Impacts Summary

Hazards associated with the drilling program, including construction and operation, are the ones normally associated with heavy construction and industrial work. There would be a minor increased risk to the public caused by project implementation resulting from additional drilling and production-related traffic in the GWA II analysis area. None of these impacts occur at significant levels.

4.14.5 Cumulative Impacts

Because the probability of risk to public health and safety resulting from implementation of the Proposed Action and Alternatives A, B, and C would be low, no cumulative impacts are expected.

4.14.6 Mitigation Summary

As no potentially significant impacts would occur, there is no need for additional mitigation measures beyond measures presented in Chapter 2.

4.14.7 Residual Impacts

No residual impacts to public health and safety are expected to result with implementation of either the Proposed Action or Alternatives A, B, or C.

4.15 NOISE

4.15.1 Introduction

Implementation of the GWA II Natural Gas Development Project has the potential to create noise-generated impacts that emanate from machinery utilized during the construction of the drill sites, pipelines, access roads, and ancillary facilities, and noise generated by the operation of heavy trucks and related equipment.

4.15.2 Impact Significance Criteria

The following criteria was used to assess the significance of noise impacts related to this project:

- Long-term activities that would exceed federal 55 dBA maximum standards for noise at either residences or other sensitive locations, such as raptor nests, grouse leks, or wildlife crucial ranges.

4.15.3 Direct and Indirect Impacts

4.15.3.1 Proposed Action, Alternative A, Alternative B

Noise associated with construction and natural gas production operations can create a disturbance that affects human safety (at extreme levels) or comfort as well as modifies animal behavior. Determining activities that exceed the maximum standards is not a simple issue since perception of sound varies with intensity and pitch of the source, air density, humidity, wind direction, screening/focusing by topography or vegetation, and distance to the observer. Noise levels in excess of the 55 dBA maximum standards can occur at construction and production operations. Under typical conditions, excess levels decline below the level of significance (55 dBA) at 3,500 feet from the source (USDI-BLM 1991). Construction-related impacts would be short-term, lasting as long as construction activities were ongoing at well sites, access roads, pipelines, and other ancillary facilities such as compressor sites. Noise would be created over a longer term at the individual well sites as a result of drilling activities.

4.15.3.2 Alternative C - No Action

Implementation of the No Action Alternative would not add to existing noise levels within the GWA II analysis area.

4.15.4 Impacts Summary

Given the low human population densities in the GWA II analysis area, construction and development operations under the Proposed Action and Alternatives A and B would be sufficiently distant from residences that none would likely be affected by construction or development operations. Overall noise produced by construction and support services equipment during peak activity periods would be moderate because of its dispersed and short-term nature.

4.15.5 Cumulative Impacts

Continuous noise would result from ongoing construction, drilling, and gas production operations during the life of the project. Increased traffic on existing transportation system roads within the GWA II analysis area would occur, thus adding to existing traffic noise. However, given the current and anticipated low and dispersed traffic volumes, and dispersed nature of gas production operations within the GWA II analysis area, these projected increases in project-related noise would not be significant.

4.15.6 Mitigation Summary

Measures to mitigate noise impacts would include the following:

- In any area of operations (drill site, compressor site, etc.) where noise levels may exceed federal OSHA and MSHA safe limits, UPRC and other GWA II operators would provide and require the use of proper personnel protective equipment by employees.

4.15.7 Residual Impacts

Implementation of mitigation measures as proposed should fully mitigate or reduce all noise impacts to levels not considered significant.

CHAPTER 5

CONSULTATION AND COORDINATION

CHAPTER 5

CONSULTATION AND COORDINATION

5.0 CONSULTATION AND COORDINATION

5.0.1 Background

An Environmental Impact Statement (EIS) must be prepared when a federal government agency considers approving an action within its jurisdiction that may impact the human environment. An EIS aids federal officials in making decisions by presenting information on the physical, biological, and social environment of a proposed project and its alternatives. As previously mentioned in Chapter 2, the first step in preparing an EIS is to determine the scope of the project, the range of action alternatives, and the impacts to be included in the document.

The Council on Environmental Quality (CEQ) regulations (40 CFR, Parts 1500-1508) require an early scoping process to determine the issues related to the proposed action and alternatives that the EIS should address. The purpose of the scoping process is to identify important issues, concerns, and potential impacts that require analysis in the EIS and to eliminate insignificant issues and alternatives from detailed analysis.

The GWA II natural gas production project EIS was prepared by a third party contractor working under the direction of and in cooperation with the lead agency for the project, which is the Bureau of Land Management (BLM) Great Divide Resource Area, and Rawlins District Office, Rawlins, Wyoming.

5.1 PUBLIC PARTICIPATION

A Scoping Statement was prepared and submitted to the public by the BLM on December 13, 1993. requesting input into the proposed GWA II natural gas production project. A total of 130 scoping documents were sent out to the public on the BLM mailing list, as well as organizations, groups, and individuals requesting a copy of the scoping document.

There were five written responses received during the scoping period in response to the GWA II natural gas production project. These written responses consisted of one letter in favor of the drilling proposal, and four letters that did not state a position in regard to the project, but provided suggested mitigation if the project were implemented. There were no letters that specifically stated the project should not be implemented. The issues and concerns identified by the public during the scoping period are summarized in Chapter 1.

During preparation of the EIS, the BLM and the consultant Interdisciplinary Team (IDT) have communicated with, and received input from various federal, state, county, and local agencies, elected representatives, environmental and citizens groups, industries, and individuals potentially concerned with issues regarding the proposed drilling action. The contacts made are summarized in the following sections.

5.1.1 Government Offices

BLM, Green River Resource Area
Carbon County Commissioners
Sweetwater County Commissioners
Sweetwater County Planning Department
Carbon County Planning Commission
U.S. Fish and Wildlife Service
Wyoming Game and Fish Department (Cheyenne, etc.)
Wyoming Geological Survey
Wyoming Oil and Gas Conservation Commission
U.S. Senator Alan K. Simpson
U.S. Congressman Craig Thomas
U.S. Senator Malcolm Wallop
Carbon County State Representative Bill Vasey
Carbon County State Senator Robert Grieve
Sweetwater County State Representative Sam Blackwell
Sweetwater County State Representative Mark Harris
Sweetwater County State Representative Richard Honaker
Sweetwater County State Representative Chris Plant
Sweetwater County State Representative Louise Ryckman
Sweetwater County State Senator Carl Maldonado
Sweetwater County State Senator Frank Prevedel
Sweetwater County State Senator Robert Reese
Mayor, Town of Wamsutter

5.1.2 Organizations

Uinta-Ouray Tribal Council
Northern Arapaho Tribal Council
Shoshone Tribal Council
Defenders of Wildlife
Friends of Wild Wyoming Deserts
Murie Audubon Society
National Audubon Society
National Wildlife Federation

Sierra Club
Sweetwater Wildlife Association
The Nature Conservancy
Wyoming Association of Professional Archaeologists
Wyoming Outdoor Council
Wyoming Public Lands Council
Wyoming Wildlife Federation

5.1.3 Industry

Union Pacific Resources Company
Amoco Production Company
Barrett Resources Company
Pacific Gas and Electric Company
Marathon Oil Company
Williams Field Services
Rocky Mountain Oil and Gas Association
Petroleum Association of Wyoming

5.1.4 Landowners/Permittees

Adams and Adams
A.L. Land and Cattle Company
Duncan Livestock Company
P.H. Livestock Company
Andy Peroulis
Quealy Livestock Company
Weber Ranch, Inc.
William H. Jolley
Curtis Rochelle
Peroulis, John and Sons
Stratton Sheep Company
Phil Weber

5.1.5 Newspapers

Rocket Miner (Rock Springs, Wyoming)
Saratoga Sun (Saratoga, Wyoming)
Casper Star Tribune (Casper, Wyoming)
Wyoming State Journal (Lander, Wyoming)
Riverton Ranger (Riverton, Wyoming)
Daily Times (Rawlins, Wyoming)

5.2 LIST OF PREPARERS

The following tables identify the core BLM ID Team (Table 5-1) and the consultant ID Team (Table 5-2) that were principally involved with preparing this EIS.

Table 5-1. List of Preparers.

Name	Responsibility
BUREAU OF LAND MANAGEMENT	
Rawlins District	
Bob Tigner/John Spehar	Project Manager
Walt George	Realty/Environmental Coordinator
Great Divide Resource Area	
Kip Purinton	Petroleum Engineer
Mary Read	Wildlife, Fisheries, T&E Species
Gregg Hiatt	Wildlife/T&E Species
Lynn Jahnke	Wildlife/T&E Species
Gary DeMarcay	Cultural Resources
Susan Foley	Soils and Watershed
Sarah Crocker	Range Resources
Mark Newman	Geology and Hydrology
Roger Miller	Hydrology
Mark Newman	Paleontology
Clare Miller	Environmental Compliance
Ray Hanson	Recreation/Visual Resource Management
Tim Bottomley	Environmental Coordinator
Roger Miller	Geology
Mary Apple	Public Affairs
Missy Cook	Clerical/Environmental Coordinator
Richard Larsen	Hazardous Materials

Table 5-2. List of Consultant ID Team EIS Preparers.

Name	Affiliation	Responsibility
Gary Holsan	Gary Holsan Environmental Planning	Interdisciplinary Team Leader, Project Manager, Health and Safety
Oliver John Grah	ECOTONE Environmental Consulting, Inc.	Assistant Project Manager, Soils, Water Resources, Vegetation and Wetlands, Reclamation, Cumulative Impacts, Document Production
Karen Matsumoto	ECOTONE Environmental Consulting, Inc.	Document Edit and Production
Juli Crane	ECOTONE Environmental Consulting, Inc.	Vegetation and Wetlands
Larry Hayden-Wing	Hayden-Wing Associates	Wildlife, Fisheries
John Keith	ECOTONE Environmental Consulting, Inc.	Socioeconomics
Richard Krannich	Rocky Mountain Social Science	Socioeconomics and Recreation
Craig Johnson	ECOTONE Environmental Consulting, Inc.	Visual Resources and Recreation
Clifford Cole	TRC Environmental Corporation	Air Quality
Jana Pastor	Western Wyoming College	Cultural Resources
Gustav Winterfeld	Erathem-Vanir Geological Consultants	Geology/Paleontology
Ron Dean	Gary Holsan Environmental Planning	Range Resources
Marlene Rebori	ECOTONE Environmental Consulting, Inc.	Document Review
Shelley Williams	ECOTONE Environmental Consulting, Inc.	Document Edit and Production

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GLOSSARY

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abandon: To cease producing oil or gas from a well when it becomes unprofitable. A wildcat (exploration) well may be abandoned after it has been proven nonproductive. Usually, some of the casing is removed and salvaged, and one or more cement plugs placed in the borehole to prevent migration of fluids between formations.

ablation: The loss of snow cover through the combined action of sublimation, snow melt, evaporation, wind erosion, and soil infiltration.

act: The National Environmental Policy Act, as amended (42 U.S.C. 4321, et seq.) which is also referred to as "NEPA" (40 CFR 1508.2).

action alternative: Those alternatives which propose some degree of construction, development, improvement or rehabilitation. In this EIS, it includes all alternatives except Alternative C, the "No Action" alternative.

active channel: A stream channel that carries surface water regularly and frequently enough to maintain the channel free of vegetation and to establish relatively consistent channel morphology.

acre-foot: A volume of water that covers an area of one acre to a depth of one foot (43,560 cubic feet or 325,851 gallons).

acquired minerals: Mineral rights that were patented into nonfederal ownership and were later re-acquired by the United States.

aerie: The nest of an eagle or other predatory bird; usually built on a crag or other high place.

affected environment: The biological, physical, and socioeconomic environment that will or may be changed by actions proposed and the relationship of people to that environment.

agatized: Formed or shaped through volcanic processes; rocks [agates] formed in such a manner are found in vugs in volcanic rocks and in cavities of some other rocks.

airshed: A geographic area that shares the same air because of topography, meteorology, and climate.

allotment: An area of land where one or more permittees graze their livestock. Generally consists of public land but may include parcels of private or State lands. The number of livestock and season of use are stipulated for each allotment. An allotment may consist of several pastures or be only one pasture.

Allotment Management Plan: The document that contains the action program needed to manage the range resource for livestock grazing with consideration given to soil, watershed, wildlife, recreation, timber and other resources on lands within a range allotment or on a wild horse or burro territory. Allotment management plans, territory plans, and where appropriate, coordinated resource management plans identify prescriptions and practices for the management or grazing and browsing lands for livestock and wild horses and burros.

alkaline soil: A soil with a pH of 8.5 or greater or at least 15 percent exchangeable sodium or both. Plant growth is typically reduced in such soils.

alluvium: A general term for all detrital deposits resulting from the operations of modern rivers, thus including the sediment laid down in riverbeds, floodplains, lakes, fans at the foot of mountain slopes, and estuaries.

alternative: A combination of management prescriptions applied in specific amounts and locations to achieve a desired management emphasis or expressed in goals and objectives. One of several policies, plans, or projects proposed for decision making.

alternative, No Action: An alternative that maintains established trends or management direction.

animal unit month (AUM): The amount of forage necessary for the sustenance of a 1,000-lb dry cow in maintenance or gestation or five sheep for 1 month.

annulus: The space around a pipe in a wellbore, the outer wall of which may be the wall of either the borehole or the casing.

Application for Permit to Drill, Deepen or Plug Back (APD): The Department of Interior application permit form to authorize oil and gas drilling activities on federal land.

aquatic bed: Wetland and deepwater habitats dominated by plants that primarily grow on or below the surface of the water. For comparison, see Emergent Vegetation.

aquifer: A water-bearing bed or layer of permeable rock, sand, or gravel capable of yielding water; or the part of a water-drive reservoir that contains the aquifer.

archaeological resources: All prehistoric and historic physical evidence of past human activity which can be used to reconstruct lifeways and cultural history of past peoples. These resources include sites, artifacts, environmental data, and all other relevant information and the contexts in which they occur.

artifact: Any object made, modified, or used by humans, usually movable. Objects which are recorded as prehistoric or historic artifacts have sociocultural or scientific values and meet the general criterion of being more than 50 years old.

at depth: A reference made to some depth relatively deep in the earth's surface.

badland: Steep or very steep, commonly non-stony barren land dissected by many intermittent drainage channels. Badland is most common in semi-arid and arid regions where streams are entrenched in soft geologic material. Runoff potential is very high, and geologic erosion is active in such areas.

base flow: Sustained runoff composed largely of groundwater discharge.

big game: Those species of large mammals normally managed as a sport hunting resource.

BLM: See Bureau of Land Management.

blowout: An uncontrolled expulsion of gas, oil, or other fluids from a drilling well. A blowout or "gusher," occurs when formation pressure exceeds the pressure applied to it by the column of drilling fluid and when blowout prevention equipment is absent or fails.

borehole: A circular hole made by boring; especially a deep hole of small diameter, such as an oil well or a water well.

Bureau of Land Management (BLM): The Department of Interior agency responsible for managing most Federal Government subsurface minerals. It has surface management responsibility for Federal lands designated under the Federal Land Policy and Management Act of 1976.

calcareous: Containing calcium carbonate. When applied to a rock name, it implies that as much as 50% of the rock is calcium carbonate.

candidate species: Species that are presently being considered to be added to the list as either threatened or endangered. Results depend on further studies.

carrying capacity: The ability of an area of land to sustain a species [generally livestock] over time without permanently degrading the land resources.

casing: Steel pipe placed in an oil or gas well to prevent the hole from collapsing.

CEQ: See Council of Environmental Quality.

CFR: Code of Federal Regulations.

cfs: Cubic Feet Per Second; a measure of streamflow volume. One cubic foot is 7.48 gallons. A flow of 1 cfs would produce 448.8 gallons per minute.

channery soil: A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches long. A single piece is called a fragment.

chert: A hard, dense microcrystalline or cryptocrystalline sedimentary rock, composed chiefly of interlocking crystals of quartz and possibly some amorphous silica (opal). Occurs principally in limestone and dolomite and may be an organic or an inorganic precipitate or replacement product. Also synonymous with *flint*.

Class(es): As they refer to streams, airsheds, archeology

Airshed Classes: Atmospheric stability class is the measure of the atmospheric turbulence, and affects the potential for pollutant dispersion. The stability is divided into six categories, designated "A" through "F." The greatest pollutant dispersion occurs during class "A," and the least occurs during class "F". The table below shows the wind direction distribution (direction from which the wind blows).

Wind Speed and Stability Class Distributions.

Wind Speed (knots)	Frequency (percent)	Stability Class	Frequency (percent)
0-3	11.7	A	0.81
4-6	28.9	B	5.18
7-10	28.9	C	11.19
11-16	23.0	D	50.80
17-21	9.7	E	17.54
Greater than 21	3.2	F	14.48

Source: SCRAM, 1994.

Archeological Classes: Classes used to categorize levels of study/analysis of an archeological site. Classes utilize roman numerals; i.e., Class I, II, II.

Stream/Fisheries Classes:

Class 1 - surface waters in which no further water quality degradation by point source discharges other than from dams will be allowed. Nonpoint sources of pollution shall be controlled with appropriate best management practices. Considerations employed during the designation of these waters include water quality, aesthetic, scenic, recreational, ecological, agricultural, geological, the presence of significant quantities of developable water, and other values of present and future benefit to people.

Class 2 - surface waters other than Class 1 determined to be presently supporting game fish or have the hydrologic and natural water quality potential to support game fish, or include nursery areas or food sources for game fish.

Class 3 - surface waters other than Class 1 which are determined to be presently supporting non-game fish only, or have the hydrologic and natural water quality potential to support non-game fish only, or include nursery areas or food sources for non-game fish only.

Class 4 - surface waters other than Class 1 which are determined to not have the hydrologic or natural water quality potential to support fish.

Class 5 - surface waters/streams incapable of supporting fish.

Visual Management Classes: Management classes for visuals describe different degrees of modification allowed to the basic elements of the landscape. Class designations are derived from an overlay technique that combines the maps of Scenic Quality, Sensitivity Levels and Distance Zones. Scenic quality uses subcategories to narrow a class into a further subdivided A, B, or C class with "A" being the highest. Sensitivity Level is rated on a High-Medium-Low scale based on user attitude and use volume. Distance zones characterize viewsheds and distances to them by the using the terms foreground/middleground, background and seldom seen to identify the predominance and importance of such areas visually/aesthetically. The overlays of each of these major mapped categories are used to identify areas with similar combinations of factors. These areas are assigned to one of five management classes according to predetermined criteria. Changes allowable under each class designation are discussed below.

Class 1 - Natural ecological changes and very limited management activity are allowed. Any contrast created within the characteristic landscape must not attract attention. This classification is applied to wilderness areas, wild and scenic rivers, and other similar situations.

Class 2 - Changes in any of the basic elements (form line, color, texture) caused by a management activity should not be evident in the characteristic landscape. Contrasts are seen, but must not attract attention.

Class 3 - Contrasts to the basic elements caused by a management activity are evident, but should remain subordinate to the existing landscape.

Class 4 - Any contrast attracts attention and is a dominant feature of the landscape in terms of scale, but it should repeat the form, line, color and texture of the characteristic landscape.

Class 5 - The classification is applied to areas where the natural character of the landscape has been disturbed to a point where rehabilitation is needed to bring it up to one of the four other classifications. The classification also applies to areas where unacceptable cultural modification has lowered scenic quality; it is often used as an interim classification until objectives of another class can be reached.

closed mud system: A drill mud system that reuses or reclaims all the drilling fluid used. Oil-base mud systems are often closed mud systems.

colluvium: A general term applied to loose and incoherent deposits, usually at the foot of a slope or cliff and brought there chiefly by gravity. Talus and cliff debris are included in such deposits.

community: An aggregate of organisms that form a distinct ecological unit. Such a unity may be defined in terms of plants, animals, or both.

completion: The activities and methods to prepare a well for production. Includes installation of equipment for production from an oil or gas well.

cooperating agency: Any Federal agency other than a lead agency which has jurisdiction by law or special expertise with respect to any environmental impacts involved in a proposal (or a reasonable alternative) for legislation or other major Federal action significantly affecting the quality of the human environment. The selection and responsibilities of a cooperating agency are described in (1501.6). A State or local agency of similar qualifications or, when the effects are on a reservation, an Indian Tribe, may by agreement with the lead agency become a cooperating agency.

Council: The Council on Environmental Quality established by Title II of the National Environmental Policy Act of 1969.

Council on Environmental Quality: An advisory council to the President established by the National Environmental Policy Act of 1969. It reviews Federal programs for their effect on the environment, conducts environmental studies, and advises the President on environmental matters.

cover: The material covering the soil and providing protection from, or resistance to, the impact of raindrops and the energy of overland flow, and expressed in percent of the area covered. Composed of vegetation, litter, small rock, and large rocks. These materials may be lying on or within 20 feet of the ground surface.

cover type: A term describing the general characteristic or attribute of an area, often based on vegetative characteristics.

cratonic: of or referring to part of the earth's crust that has attained stability and has been little deformed for a long time; restricted to continents.

critical wildlife habitat: That portion of wildlife habitat that is essential to the survival and perpetuation of threatened and endangered species as designated by the U.S. Fish and Wildlife Service.

crucial range: Any particular seasonal range or habitat component that has been documented as the determining factor in a population's ability to maintain itself at a certain level over the long-term.

cubic feet per second (cfs): The rate of discharge representing a volume of 1 cubic foot of water passing a given point during 1 second.

cultural resources: The physical remains of human activity (artifacts, ruins, burial mounds, petroglyphs, etc.) and the conceptual content or context (as a setting for legendary, historic, or prehistoric events, such as a sacred area of native peoples, etc.) of an area of prehistoric or historic occupation.

cumulative action: Actions, which when viewed with other proposed actions have cumulatively significant impacts and should therefore be discussed in the same impact statement. (40 CFR 1508.25).

cumulative impact: 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 taken place over a period of time. (40 CFR 1508.7).

decibel: A unit of measurement of noise intensity. The measurements is based on the energy of the sound waves and units are logarithmic. Changes of 5 decibels or more are normally discernable to the human ear.

decision document: A record of decision, decision memo, or decision notice.

deepen: To increase the depth of a well. Deepening is generally a workover operation to produce from a deeper formation or to control excessive gas found in the upper levels of a reservoir.

demographics: The statistical characteristics of a human population.

detrivores: Refers to organisms which feed on fragmented particulate organic matter.

development well: A well drilled in proven territory (usually within 1 mile of an existing well).

directional drilling: The intentional deviation of a wellbore from vertical to reach subsurface areas off to one side from the drilling site.

displacement: As applied to wildlife, forced shifts in the patterns of wildlife use, either in location or timing of use.

disposal well: A well into which produced water from other wells is injected into an underground formation for disposal.

dissolved solids: The total amount of dissolved material, organic and inorganic, contained in water or wastes.

drill pad: Relatively flat work area that contains equipment and facilities used for well drilling and well completion.

drill pipe: The heavy seamless tubing used to rotate the drill bit and circulate the drilling fluid. The standard drill pipe section is 30 feet long (a joint).

drill rig: The mast, draw works, and attendant surface equipment of a drilling workover unit.

dry hole: Any well incapable of producing oil or gas in commercial quantities. A dry hole may produce water, gas or even oil, but not enough to justify production.

dry deposition: Particulates that settle in dry form (often from dust that condenses on gases in atmosphere, e.g., from smokestacks); the laying-down of rock-forming material by any natural agent except water.

ecosystem: Collectively, all populations in a community, plus the associated environmental factors.

ecotone: A transition area, for example the zone between two distinct plant communities like aspen and spruce/fir.

effects: These include: a) **Direct effects**, which are caused by the action and occur at the same time and place; b) **Indirect effects**, which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems. Effects and impacts as used in these regulations are synonymous. Effects includes ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic, social, or health, whether direct, indirect, or cumulative.

Effects may also include those resulting from actions which may have both beneficial and detrimental effects, even if on balance the agency believes that the effect will be beneficial (40 CFR 1508.8).

effluent: A discharge of pollutants, partially or completely treated or in its natural state into the environment. Generally used in regard to discharges into waters.

egress: Opposite of ingress (see ingress). Act/ability of leaving/exiting; permission granted for exit (as in permission to exit an area gained entrance through permit, etc.).

emergent vegetation: Erect, rooted, herbaceous plants that project out of the water, or "emerge." For comparison, see aquatic bed.

endangered animal species: Any animal species in danger of extinction throughout all or a significant portion of its range. This definition excludes species of insects that the Secretary of the Interior determines to be pests and whose protection under the Endangered Species Act of 1973 would present an overwhelming and overriding risk to man.

endangered plant species: Species of plants in danger of extinction throughout all or a significant portion of their ranges. Existence may be endangered because of the destruction, drastic change, or severe curtailment of habitat, or because of over exploitation, disease, predation, or even unknown reasons. Plant taxa from very limited areas (e.g. the type localities only), or from restricted fragile habitats usually are considered endangered.

endemic: Restricted to a geographic region, topographic unit, or particular soil condition.

environmental analysis (EA): An investigation of a proposed action and alternatives to that action and their direct, indirect, and cumulative environmental impacts; the process which provides the necessary information for reaching an informed decision and the information needed for determining whether a proposed action may have significant environmental effects and determining the type environmental documents required.

environmentally conservative: Assumes an environmental outcome usually greater in impacts than the real outcome of an action; a method used or conclusion reached where the assessed impact is of a greater magnitude than that expected to occur as a result of the implemented action.

environmental impact statement (EIS): A detailed written statement as required by Sec. 102(2)(C) of the National Environmental Policy Act.

ephemeral stream: A stream that flows only in direct response to precipitation in the immediate watershed or in response to the melting of a cover of snow and ice and which has a channel bottom that is always above the local water table.

erosion: The removal, detachment, and entrainment of earth materials by weathering, dissolution, abrasion, and corrosion, later to be transported by moving water, wind, gravity, or glaciers.

evaporite: One of the sediments which are deposited from aqueous solution as a result of extensive or total evaporation. Examples include anhydrite, rock salt, and various nitrates and borates.

existing visual condition (EVC): The present state of visual alteration of the natural-appearing landscape by man-made objects. Five classes: (1) Untouched, (2) Unnoticed, (3) Minor Disturbance, (4) Disturbed (5) Major Disturbance.

exploration well: A well drilled in an area where there is no oil or gas production. Same as a "wildcat" well (see wildcat well).

federal lands: All lands and interests in lands owned by the U.S. that are subject to the mineral leasing laws, including mineral resources or mineral estates reserved to the U.S. in the conveyance of a surface or non-mineral estate.

FEIS: Final Environmental Impact Statement (see environmental impact statement).

floodplain: As defined by Executive Order 11988, as amended, lowland and relatively flat areas adjoining inland and coastal waters including flood prone areas of offshore islands, including at a minimum, that area subject to a one percent or greater chance of flooding in any given year.

forage: Vegetation of all forms available for animal consumption.

forb: A broad-leafed flowering herb other than grass.

fracturing (fracing): A method of stimulating well production by increasing the permeability of the producing formation. Under extremely high hydraulic pressure, the fracturing fluid (water, oil, dilute hydrochloric acid, or other fluid) is pumped into the formation which parts or fractures it. Proppants or propping agents such as sand or glass beads are pumped into the formation as part of the fracturing job. The proppants become wedged in the open fractures, leaving channels for oil to flow into the well after the hydraulic fracture pressure is released. this process is often called a "frac job." When high concentrations of acid are used, it may be called an "acid frac job."

functional value: A term that refers to the various functions performed by wetlands and the values people place on those functions. Functions are the chemical, physical, and biological processes or attributes of a wetland without regard to their importance to society. They include groundwater recharge and discharge, sediment trapping, nutrient/pollutant retention and removal, shoreline anchoring and dissipation of erosive forces, food chain support, wildlife and fish habitat, and heritage value (including active and passive recreation, uniqueness, etc.).

game species: Any species of wildlife or fish for which seasons and bag limits have been prescribed, and which are normally harvested by hunters, trappers, or fishermen under State or Federal Laws, codes, and regulations.

gastropod: Any mollusk belonging to the class Gastropoda, characterized by a distinct head with eyes and tentacles and in most, by a single calcareous shell. Range: Upper Cambrian to present.

graminoid: A plant that looks like a grass, including grasses and grass-like species such as bulrush, sedge, or spikerush.

gully: A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall.

habitat: A specific set of physical conditions that surround a single species, a group of species, or a large community. In wildlife management, the major components of habitat are considered to be food, water, cover, and living space.

habitat type: An aggregation of all land areas potentially capable of producing similar plant communities of climax.

hafted: To fit or equip with a hilt or handle.

halophyte: A plant adapted for growing in salty soil.

hardness: A means of describing the degree to which the calcium and magnesium dissolved in water combine with soap to form an insoluble curd. Water with 0-60 mg/L $CaC0_3$ is soft water, 61-120 mg/L is moderately hard, 121-180 mg/L is hard, and more than 180 mg/L is very hard water.

historic resources: All evidences of human activity that date from historic (recorded history) periods.

human environment: The factors that include, but are not limited to biological, physical, social, economic, cultural and aesthetic factors that interrelate to form the environment.

hydric soils: A soil that is saturated, flooded, or ponded with water long enough during the growing season (i.e., soil temperature of 41°F at 20 inches depth) to develop anaerobic soil conditions (i.e., reduced oxygen levels). These soils develop characteristics that are indicative of the wet and anaerobic conditions. Such characteristics may include an undecomposed organic surface layer (histic epipedon), surface horizons with low chromas (i.e., very dark brown to black), organic staining and streaking, grey-colored layers of horizons, iron concretions, and/or light grey- or rust-colored mottles or specks of highly contrasting color. These characteristics must generally occur within 50 percent of the root zone.

hydrophytic plants: Those species which either require or tolerate wet or saturated soils and are therefore indicative of these conditions. Vegetation is a good indicator of the physical conditions on a given site. Such conditions include soil moisture.

hydrostratigraphy: The relationship of subsurface geologic units to the occurrence of aquifers and groundwater.

impact: The results of an action on the environment; the impact may be primary (direct) or secondary (indirect); the term impact is synonymous with effect according to 40 CFR 1508.8.

indicator species: A species of animal or plant whose presence is a fairly certain indication of a particular set of environmental conditions. Indicator species serve to show the effects of development actions on the environment.

indicator wildlife species: Indicator wildlife species are defined in two general categories: 1) those that are hunted and utilize diverse habitat conditions, and 2) those that utilize restricted habitat niches, are resident species, have wide distributions over an area and/or are easily monitored.

infill: The process of drilling and completing more production wells in a specific area.

ingress: Right or ability to go in; permission granted for entrance or admittance (as in admittance by permit, to an area).

injection well: A well used to inject fluids into an underground formation to increase reservoir pressure.

insectivore: Any insect-eating plant or animal.

interbedded: Said of beds lying between or alternating with others of different character, especially said of rock material laid down in sequence between other beds, such as a contemporaneous lava flow "interbedded" with sediments.

interdisciplinary team (IDT): A group selected to work within the NEPA process in scoping, analysis, and document preparation. The purpose of the team is to integrate its collective knowledge of the physical, biological, economic, and social sciences and the environmental design arts into the environmental analysis process. Interaction among team members often provides insight that otherwise would not be apparent.

intermittent stream: A stream or reach of a stream that drains a watershed of at least one square mile; or a stream or reach of a stream that is below the local water table for at least some part of the year, and obtains its flow from both surface runoff and groundwater discharge.

interstitial: Said of a mineral deposit in which the mineral fills the pores of the host rock.

intertonguing: The disappearance of sedimentary bodies in laterally adjacent masses owing to splitting into may thin tongues each of which reaches an independent pinch-out termination; the intergradation of markedly different rocks through a vertical succession of thin interlocking or overlapping wedge-shaped layers.

irreversible: A term that describes the loss of future options. Applies primarily to the effects of use of nonrenewable resources, such as minerals or cultural resources, or to those factors, such as soil productivity that are renewable only over long periods of time.

irretrievable: A term that applies to the loss of production, harvest, or use of natural resources. For example, some or all of the timber production from an area is lost irretrievably while an area is serving as a winter sports site. The production lost is irretrievable, but the action is not irreversible. If the use changes, it is possible to resume timber production.

jurisdictional wetlands: "Those wetlands which are within the extent of COE regulatory overview" (33 CFR 328.1 and 2). For an area to be identified as a jurisdictional wetland, the area must exhibit positive indicators of wetland hydrology, hydrophytic vegetation, and hydric soils. Those areas that do not meet the three parameters are uplands or non-jurisdictional wetlands. The Corps of Engineers Wetlands Delineation Manual (Environmental Laboratory 1987) describes technical criteria for determining hydrophytic vegetation, hydric soils, and wetland hydrology, and therefore the occurrence of jurisdictional wetlands.

lag: (1) lag gravel (2) The time between the formation of potential sediment by weathering and its removal and deposition (3) The delay between the arrival of a seismic signal at a detector and the response.

lag gravel: A residual accumulation of coarse rock fragments on a surface after the finer material has been blown away by winds.

lead agency: The agency or agencies preparing or having taken primary responsibility for preparing the environmental impact statement (40 CFR 1508.16).

loam: A rich, permeable soil composed of a mixture of clay, silt, sand and organic matter.

lease: 1. A legal document that conveys to an operator the right to drill for oil and gas.
2. The tract of land on which a lease has been obtained, where producing wells and production equipment are located.

lek: (1) An assembly area for communal courtship display (2) A communal prenuptial display, specifically those displays involving ritualized contest between competitors, often for the use of symbolic sites.

marginal properties: Fee and/or federal lease holdings with natural gas/oil reserves that are approaching depletion to the extent that any profit from continued production is doubtful. An oil/gas holding becomes a marginal property when the cost to drill, complete, and equip the well exceeds the ability to recover these costs during its lifetime.

mineral rights: Reserved mineral rights are the retention of ownership of all or part of the mineral rights by a person or party conveying land to the United States. Conditions for exercising these rights have been defined in the Secretary's "Rules and Regulations to Govern Exercising of Mineral Rights Reserved in Conveyances to the United States" attached to and made a part of deeds reserving mineral rights.

mitigate: To lessen the severity.

mitigation: Avoiding the impact altogether by not taking a certain action or parts of an action; minimizing impacts by limiting the degree of magnitude of the action and its implementation; rectifying the impact by repairing, rehabilitating, or restoring the affected environment; reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and/or compensating for the impact by replacing or providing substitute resources or environments.

mud system: A system used to manage suspended mud in the well-drilling process (see also closed mud system).

National Environmental Policy Act (NEPA): The federal law established in 1969, which went into effect on January 1, 1970, that 1) established a national policy for the environment, 2) requires federal agencies to become aware of the environmental ramifications of their proposed actions, 3) requires full disclosure to the public of proposed federal actions and a mechanism for public input into the federal decision-making process, and 4) requires federal agencies to prepare an environmental impact statement for every major action that would significantly affect the quality of the human environment.

National Register of Historic Places: A list of districts, sites, buildings, structures, and objects significant in American history, architecture, archaeology, and culture.

new field discovery: A well, usually a wildcat well, that discovers a previously unknown oil and gas field.

No Action alternative: The management direction, activities, outputs, and effects that are likely to exist in the future if the current plan would continue unchanged.

nongame species: Wildlife which is not hunted for recreational purposes.

nonpoint source pollution: Sources from which the pollutants discharges are: 1) induced by natural processes, including precipitation, seepage, percolation, and runoff; 2) not traceable to any discrete or identifiable facility and 3) better controlled through the utilization of Best Management Practices, including process and planning techniques. This includes natural pollution sources not directly or indirectly caused by man.

Notice of Staking: Prior to filing a complete Application for Permit to Drill (APD) an Operator may wish to file a Notice of Staking (NOS). Under this procedure, the site is surveyed and staked, and the onsite inspection is used to provide information to the Operator prior to the Operator committing time and money in preparing an APD which might not reflect agency concerns.

noxious weeds: Officially designated undesirable or invading weedy species generally introduced into an area due to human activity.

off-road vehicle (ORV)/off-highway vehicle (OHV): A vehicle (including four-wheel drive, trail bikes, and snowmobiles but excluding helicopters, fixed-wing aircraft, and boats) capable of traveling off-road over land, water, ice, snow, sand, marshes, and other terrain.

ostracod: Any aquatic crustacean belonging to the subclass *Ostracoda*, characterized by a bivalve, generally calcified carapace with a hinge along the dorsal margin.

pan: A shallow depression, especially containing a lake or pond.

particulates: Small particles in the air and generally considered pollutants.

perennial stream: A stream or part of a stream that flows continuously during all of the calendar year as a result of groundwater discharge or surface runoff.

permeability: Extent that a substance is open to passage or penetration, especially by fluids.

permittee (grazing): A person who has livestock grazing privileges on an allotment or allotments within the resource area.

personal income: Includes both monetary and non-monetary forms of income such as medical insurance, private retirement programs and other "fringe" benefits. Usually estimated from administrative records of business and government sources.

play: An area of anticipated or known oil and gas reserves.

playa: The shallow central basin of a desert plain, in which water gathers after a rain and is evaporated.

population employment ratio: The total population of an area divided by the total number of jobs in that area.

porcellanite: A dense siliceous rock having the texture, dull luster, and general appearance of unglazed porcelain; it is less hard, dense, and vitreous than chert. The term has been used for an impure chert; for a baked clay or shale found in the roof or floor of a burned-out coal seam, and for a fine-grained acidic tuff compacted by secondary silica.

precipitation: As used in hydrology, precipitation is the discharge of water, in liquid or solid state, out of the atmosphere, generally upon a land or water surface.

preferred alternative: The alternative identified in the EIS as the action favored by the agency.

prehistoric site: Archaeologic sites associated with American Indians and usually occurring before contact with Europeans.

prevention of significant deterioration of air quality (PSD): A classification established to preserve, protect, and enhance the air quality in National Wilderness Preservation System areas in existence prior to August 1977 and other areas of National significance, while ensuring economic growth can occur in a manner consistent with the preservation of existing clean air resources. Specific emission limitations and other measures, by class, are detailed in the Clean Air Act (42 U.S.C. 1875 et 15q.).

proposed species: Any species of fish, wildlife, or plant that is proposed to be listed in the *Federal Register*.

proppants: Proppants or propping agents are substances such as sand or glass beads that are pumped into the formation as part of the fracturing job. The proppants become wedged in the open fractures, leaving channels for oil to flow into the well after the hydraulic fracture pressure is released. This process is often called a "frac job." When high concentrations of acid are used, it may be called an "acid frac job" (see also fracturing/fracing).

public domain minerals: Mineral rights that have always been the property of the United States.

range allotment: A designated area of land available for livestock grazing upon which a specified number and kind of livestock may be grazed under a range Allotment Management Plan. It is the basic land unit used to facilitate management of the range resource on National Forest System and associated lands administered by the Forest Service.

raptor: Living on prey; a group of carnivorous birds consisting of hawks, eagles, falcons, kites, vultures, and owls.

recent in age: Refers to the Holocene epochs of the Quaternary period, from the end of the Pleistocene, approximately 8 thousand years ago, to the present time; also, the corresponding series of rocks and deposits. When the Quaternary is designated as an era, the Holocene is considered to be a period.

reclamation: Rehabilitation of a disturbed area to make it acceptable for designated uses. This normally involves regrading, replacement of topsoil, revegetation and other work necessary to restore it for use.

recreation resources: Formally designated areas and informal dispersed areas that are managed by federal, state and local agencies in order to preserve and further their use for play, amusement, or relaxation.

recurrence interval: (1) the average time interval between actual occurrences of a hydrologic event of a given or greater magnitude; (2) in and annual flood series, the average interval in which a flood of a given size recurs as an annual maximum; and (3) in partial duration series, the average interval between floods of a given size, regardless of their relationship to the year or any other period of time.

reserve pit: (1) Usually an excavated pit that may be lined with plastic, that holds drill cuttings and waste mud. (2) Term for the pit which holds the drilling mud.

revegetation: The re-establishment and development of self-sustaining plant cover. On disturbed sites, human assistance will speed natural processes by seed bed preparation, reseeding and mulching.

rig: Short for drill rig (see drill rig).

right-of-way (ROW): The legal right for use, occupancy, or access across land or water areas for a specified purpose or purposes.

riparian: Land areas which are directly influenced by water. They usually have visible vegetative or physical characteristics showing this water influence. Streamsides, lake borders, or marshes are typical of riparian areas.

riparian area: Geographically delineable areas with distinctive resource values and characteristics that are comprised of the aquatic and riparian ecosystems.

riparian ecosystem: A transition between the aquatic ecosystem and the adjacent terrestrial ecosystem; identified by soil characteristics or distinctive vegetation communities that require free or unbound water.

rip rap: A foundation or erosion control device consisting of rocks thrown together without order.

rotenone: A chemical that acts as a sterilizer to harvest all fish species present in a water body in order to introduce or re-introduce a desired species.

saline: Containing common salt or any of the salts of alkali metals or magnesium.

scoping: An early and open process for determining the scope of issues to be addressed in an EIS and for identifying the significant issues related to a proposed action. Scoping may involve public meetings, field interviews with representatives of agencies and interest groups, discussions with resource specialists and managers, and written comments in response to news releases, direct mailings, and articles about the proposed action and scoping meetings.

sediment: Soil or mineral transported by moving water, wind, gravity, or glaciers, and deposited in streams or other bodies of water, or on land.

seismic: Pertaining to an earthquake or earth vibration, including those that are artificially induced.

seismic exploration: Seismic exploration is used to map underground geological features to obtain information on the earth's subsurface and to locate areas where accumulations of oil and gas might occur.

Seismic waves, generated at or near the surface, penetrate the earth's crust and reflect from subsurface rock layers back to the surface. The geophysicist receives a printed record or seismograph from which is measured the depth to various strata and from which subsurface structures with a potential for oil and gas accumulation can be determined such as faults, anticlines, and folds.

Portable - Where access limitations, topography, or other restraints prevent use of trucks, portable operations can be performed. Two portable techniques exist for collecting data. These include:

(1) Surface charge programs involving the detonation of a series of as much as ten, five pound charges of 25-50 pounds of explosives at shot points located at intervals along the seismic line. Surface charges can be placed directly on the ground, on snow, or on a variety of stakes or platforms. All necessary equipment to conduct the operation is transported by helicopter and then conveyed by foot travel.

(2) Various kinds of portable drills can be backpacked or delivered by helicopter to the area. A shallow subsurface portable program would involve drilling a pattern of approximately 16 holes, per mile of line, about 4 inches in diameter and up to 50 feet deep. At this depth, a 10 to 40 pound charge of explosive is placed and detonated. Recording cables and geophones are laid out by foot travel.

With both of these portable techniques, shock waves generated by detonation are received and transmitted via geophones and cable to a recording device. Portable methods are generally used on rough terrain.

Conventional - The conventional method of collecting seismic data includes the use of truckmounted drills and vehicle-supported crews and generally involves off-road travel. This technique involves drilling 5 to 18, 5-inch diameter holes per mile to a depth of 180 to 200 feet. At this depth, a 10 to 50 pound explosive charge is placed and detonated. Shock waves are received and transmitted via geophones and cable to a truckmounted recording device.

Vibroseis - The vibroseis technique involves using truck-mounted hydraulic pads which generate energy waves through vibration rather than explosives. The vibrator method typically consists of four large trucks each equipped with a vibrator (a steel slab weighing about three tons mounted between the front and back wheels of a large truck). The vibrator pads (about 4 feet square) are lowered to the ground and the vibrators on the truck are triggered electronically from the recorder truck. Energy waves are received and transmitted via cable and geophones to a recorder truck. After the information is recorded, the trucks move forward a short distance and the process is repeated. The vibroseis operation is usually limited to roads and gentle terrain.

seismic operations: Use of explosive or mechanical thumpers to generate shock waves that can be read by special equipment to indicate subsurface conditions.

sensitive: Species not yet officially listed as rare under the Rare and Endangered Species Act but which are undergoing a status review or are proposed for listing according to Federal Register notices published by the Secretary of the Interior or the Secretary of Commerce or according to comparable state documents published by state officials.

significant impact: A meaningful standard to which an action may impact the environment. The impact may be beneficial, adverse, direct, indirect, or cumulative, and may have short-term or long-term effects.

silt: Any earthy material composed of fine particles, smaller than sand but larger than clay, suspended in or deposited by water.

soil productivity: The capacity of a soil to produce a specific crop such as fiber and forage, under defined levels of management. It is generally dependent on available soil moisture, nutrients and length of growing season.

soil stockpile: Piles of surface soil and rocks stored for use in site restoration.

sour well: A condition caused by the presence of hydrogen sulfur compound in an oil or gas well.

special aquatic sites: "Geographic areas, large or small, possessing special ecological characteristics of productivity, habitat, wildlife protection, or other important and easily disrupted ecological values" (40 CFR Section 230.3). Special aquatic sites include sanctuaries and refuges, wetlands, mud flats, vegetated shallows, coral reefs, and pool and riffle complexes (40 CFR Part 230 Subpart E).

species: 1) The classification level of biological nomenclature which categorized each group of related organisms potentially capable of interbreeding; 2) the accepted level of classification to differentiate one specific type of organism from another.

species of concern: Species of concern include federally listed threatened or endangered species, Candidate 1 and 2 species, BLM sensitive species (Rawlins District), and species considered rare or important by the Wyoming Natural Diversity Database (WYNDD).

spp.: An abbreviation for the plural of species.

standard lease terms: The basic BLM oil and gas leasing legal document that contains all the basic terms and conditions of the lease and identifies/defines BLM and surface management agency authorities, legal requirements, and general resource protection and mitigation requirements.

stipulation: A legal requirement, specifically a requirement that is part of the terms of a mineral lease. Some stipulations are standard on all federal leases. Other stipulations may be applied to the lease at the discretion of the surface management agency to protect valuable surface resources.

stromalitic: Of a rock-like sedimentary structure found in warm, shallow marine habitats; built up from mats of blue-green algae and trapped sediment particles; also found as fossils.

subsidence: (1) The sinking of a large part of the earth's crust. (2) Geologic movement in which there is no free side and the surface material is displaced vertically downward with little or no horizontal component.

succulent: A plant that is fleshy, juicy (i.e., a cactus).

surface lands: Lands consisting of the outside part of the solid earth or ocean as contrasted with subsurface or below surface land use(s) such as drilling and mining.

sweet well: An oil or gas well lacking sulfur and any significant amount of hydrogen sulfide or mercaptans.

tank battery: A group of production tanks that store crude oil in the field.

threatened and endangered species: Any species, plant or animal, which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its' range. Threatened species are identified by the Secretary of the Interior in accordance with the 1973 Endangered Species Act.

threatened animal species: Any animal species likely to become endangered within the foreseeable future throughout all or a significant part of its range.

threatened plant species: Species of plants that are likely to become endangered within the foreseeable future throughout all or a significant portion of their ranges, including species categorized as rare, very rare, or depleted.

tongue: A minor lithostratigraphic unit of limited extent, especially a member that extends outward beyond the main body of a formation and disappears laterally, usually by facies change.

topography: The features of the earth, including relief, vegetation, and waters.

topsoil: The uppermost layers of naturally occurring soils suitable for use as a plant growth medium.

tuff: A general term for all consolidated pyroclastic rocks.

usable water zones: Usable water is defined as groundwater with a TDS of 10,000 ppm or less encountered at any depth.

ustic: Of limited or intermediate soil moisture levels.

vibrator: A steel slab weighing about three tons mounted between the front and back wheels of a large truck. The vibrator pads (about 4 feet square) are lowered to the ground and the vibrators on the truck are triggered electronically from a recorder truck (see also seismic exploration [vibroseis]).

visual absorption capability (VAC) - A measure of the relative ability of the landscape to absorb visual change. VAC estimates the inherent resistance or susceptibility (vulnerability) to degradation of visual quality.

visual management system: A management system used that establishes the "visual landscape" as a basic resource, treated as an essential part of the land. The visual management system provides a framework to inventory the visual resource and provides measurable standards for management.

visual resource(s): The composite of basic terrain, geologic features, water features, vegetative patterns, and land use effects that typify a land unit and influence the visual appeal the unit may have for visitors.

visual sensitivity levels: An index of the relative degree of user interest in scenic quality and concern and attitude for existing or proposed changes in the landscape features of an area in relation to other areas in the planning unit.

Visual Resource Management (VRM): A system of visual management used by the BLM. The program has a dual purpose: to manage the quality of the visual environment and to reduce the visual impact of development activities while maintaining effectiveness in all Bureau resource programs. VRM also identifies scenic areas that warrant protection through special management attention. The system uses five classes for categorizing visual resources. See also Classes [visual management].

Waters of the U.S.: Include the territorial seas; interstate waters; navigable waterways (such as lakes, rivers, and streams), special aquatic sites, and wetlands that are, have been, or could be used for travel, commerce, or industrial purposes; tributaries; and impoundments of such waters. All channels that carry surface flows and that show signs of active water movement are waters of the U.S. Similarly, all open bodies of water (except ponds and lakes created on upland sites and used exclusively for agricultural activities and aesthetic amenities) are waters of the U.S.

watershed: The entire area that contributes water to a drainage system or stream.

water table: The upper limit of the portion of the ground that is wholly saturated with water.

wellbore: The diameter of the hole to be drilled.

well pad: Relatively flat work area that contains equipment and facilities used for oil/gas production.

wet deposition: Material in-solution that settles as precipitation (i.e., acid rain).

wetland: Those areas that are inundated or saturated with surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

wetland hydrology: Includes permanent or periodic inundation or saturation to the soil surface for a significant period during the growing season on a regular basis. Wetland hydrology may be supplied by surface water (i.e., streams), groundwater, and/or direct precipitation. In cases of saturation from inundation, the saturation generally must occur with a 2-year frequency interval, or 50 years out of 100 years. Saturation must occur within 50 percent of the root zone for forb and graminoid species. In addition, saturation must occur for 12.5 percent (approximately 11 consecutive days) of the growing season (Environmental Laboratory 1987).

wildcat well: An exploratory well drilled in an area where there is no oil or gas production (see exploration well).

wildlife: All species of mammals, birds, fish, amphibians, reptiles, and invertebrates found in a wild state.

wildlife habitat: All elements of a wild animal's environment necessary for completion of its life cycle. These elements include food, cover, water, and living space.

wind rose: Any of a class of meteorological diagrams depicting the distribution of wind direction over a period of time.

Windy Gap Process [Decision]: According to the "Windy Gap Decision" of the FWS, any cumulative depletion in flow to the upper basin of the Colorado River System is considered to have a possible effect on the survival and recovery of these listed species.

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APPENDICES

APPENDIX A

STANDARD MITIGATION GUIDELINES

APPENDIX A

STANDARD MITIGATION GUIDELINES

1.0 SURFACE DISTURBANCE MITIGATION GUIDELINE

Surface disturbance will be prohibited in any of the following areas or conditions. Exception, waiver, or modification of this limitation may be approved in writing, including documented supporting analysis, by the Authorized Officer (AO).

a. Slopes in excess of 25 percent.

b. Within important scenic areas (Class I and II Visual Resource Management Areas).

c. Within 500 feet of surface water and/or riparian areas.

d. Within either one-quarter mile or the visual horizon (whichever is closer) of historic trails.

e. Construction with frozen material or during periods when the soil material is saturated or when watershed damage is likely to occur.

1.1 Guidance

The intent of the SURFACE DISTURBANCE MITIGATION GUIDELINE is to inform interested parties (potential lessees, permittees, or operators) that when one or more of the five (1a through 1e) conditions exist, surface-disturbing activities will be prohibited unless or until a permittee or his designated representative and the surface management agency (SMA) arrive at an acceptable plan for mitigation of anticipated impacts. This negotiation will occur prior to development.

Specific criteria (e.g., 500 feet from water) have been established based upon the best information available. However, such items as geographical areas and seasons must be delineated at the field level.

Exception, waiver, or modification of requirements developed from this guideline must be based upon environmental analysis of proposals (e.g., activity plans, plans of development, plans of operation, applications for permit to drill) and, if necessary, must allow for other mitigation to be applied on a site-specific basis.

2.0 WILDLIFE MITIGATION GUIDELINE

a. To protect important big game winter habitat, activities or surface use will not be allowed from November 15 to April 30 within certain areas encompassed by the authorization. The same criteria apply to defined big game birthing areas from May 1 to June 30.

Application of this limitation to operation and maintenance of a developed project must be based on environmental analysis of the operational or production aspects.

Exception, waiver, or modification of this limitation in any year may be approved in writing, including documented supporting analysis, by the Authorized Officer.

b. To protect important raptor and/or sage and sharp-tailed grouse nesting habitat, activities or surface use will not be allowed from February 1 to July 31 within certain areas encompassed by the authorization. The same criteria apply to defined raptor and game bird winter concentration areas from November 15 to April 30.

Application of this limitation to operation and maintenance of a developed project must be based on environmental analysis of the operation or production aspects.

Exception, waiver, or modification of this limitation in any year may be approved in writing, including documented supporting analysis, by the Authorized Officer.

c. No activities or surface use will be allowed on that portion of the authorization area identified within (*legal description*) for the purpose of protecting (e.g., sage/sharp-tailed grouse breeding grounds, and/or other species/activities) habitat.

Exception, waiver, or modification of this limitation in any year may be approved in writing, including documented supporting analysis, by the Authorized Officer.

d. Portions of the authorized use area legally described as (*legal description*), are known or suspected to be essential habitat for (*name*) which is a threatened or endangered species. Prior to conducting any onsite activities, the lessee/permittee will be required to conduct inventories or studies in accordance with BLM and U.S. Fish and Wildlife Service guidelines to verify the presence or absence of this species. In the event that (*name*) occurrence is identified, the lessee/permittee will be required to modify operational plans to include the protection requirements of this species and its habitat (e.g., *seasonal use restrictions, occupancy limitations, facility design modifications that apply*).

2.1 Guidance

The WILDLIFE MITIGATION GUIDELINE is intended to provide two basic types of protection: 1) seasonal restriction (2a and 2b), and 2) prohibition of activities or surface use (2c). Item 2d is specific to situations involving threatened or endangered species. Legal descriptions will ultimately be required and should be measurable and legally definable. There are no minimum subdivision requirements at this time. The area delineated can and should be defined as necessary, based upon current biological data, prior to the time of processing an application and issuing the use authorization. The legal description must eventually become a part of the condition for approval of the permit, plan of development, and/or other use authorization.

The seasonal restriction section identifies three example groups of species and delineates three similar time frame restrictions. The big game species including elk, moose, deer, antelope, and bighorn sheep; all require protection of crucial winter range between November 15 and April 30. Elk and bighorn sheep also require protection from disturbance from May 1 to June 30, when they typically occupy distinct calving and lambing areas. Raptors include eagles, accipiters, falcons, (peregrine, prairie, and merlin), kestrels, buteos (ferruginous and Swainson's hawks), osprey, burrowing owls, and short-eared owls. The raptors and sage and sharp-tailed grouse require nesting protection between February 1 and July 31. The same birds often require protection from disturbance from November 15 through April 30 while they occupy winter concentration areas.

Item 2c, the prohibition of activity or surface use, is intended for the protection of specific wildlife habitat areas or values within the use area that cannot be protected by using seasonal restrictions. These areas or values must be factors that limit life-cycle activities (e.g., *sage grouse strutting grounds, known threatened and endangered species habitat*).

Exception, waiver, or modification of requirements developed from this guideline must be based upon environmental analysis of proposals (e.g., activity plans, plans of development, plans of operation, applications for permit to drill) and, if necessary, must allow for other mitigation to be applied on a site-specific basis.

3.0 CULTURAL RESOURCE MITIGATION GUIDELINE

When a proposed discretionary land use has potential for affecting the characteristics which qualify a cultural property for the National Register of Historic Places (National Register), mitigation will be considered. In accordance with Section 106 of the Historic Preservation Act, procedures specified in 36 CFR 800 will be used in consultation with the Wyoming State Historic Preservation Officer and the Advisory Council on Historic Preservation in arriving at determinations regarding the need and type of mitigation required.

3.1 Guidance

The preferred strategy for treating potential adverse effects on cultural properties is "avoidance." If avoidance involves project relocation, the new project area may also require cultural resource inventory. If avoidance is imprudent or unfeasible, appropriate mitigation may include excavation (data recovery), stabilization, monitoring, protection barriers and signs, or other physical and administrative measures.

Reports documenting results of cultural resource inventory, evaluation, and the establishment of mitigation alternatives (if necessary) shall be written according to standards contained in BLM Manuals, the cultural resource permit stipulations, and in other policies issued by the BLM. These reports must provide sufficient information for Section 106 consultation. Reports shall be reviewed for adequacy by the appropriate BLM cultural resource specialist. If cultural properties on, or eligible for, the National Register are located within these areas of potential impact and cannot be avoided, the Authorized Officer shall begin the Section 106 consultation process in accordance with the procedures contained in 36 CFR 800.

Mitigation measures shall be implemented according to the mitigation plan approved by the BLM Authorized Officer. Such plans are usually prepared by the land use applicant according to BLM specifications. Mitigation plans will be reviewed as part of Section 106 consultation for National Register eligible or listed properties. The extent and nature of recommended mitigation shall be commensurate with the significance of the cultural resource involved and the anticipated extent of damage. Reasonable costs for mitigation will be borne by the land use applicant. Mitigation must be cost effective and realistic. It must consider project requirements and limitations, input from concerned parties, and be BLM-approved or BLM-formulated.

Mitigation of paleontological and natural history sites will be treated on a case-by-case basis. Factors such as site significance, economics, safety, and project urgency must be taken into account when making a decision to mitigate. Authority to protect (through mitigation) such values is provided for in Federal Land Policy Management Act (FLPMA)(1976), Section 102(a)(8). When avoidance is not possible, appropriate mitigation may include excavation (date recovery), stabilization, monitoring, protection barriers and signs, or other physical and administrative protection measures.

4.0 SPECIAL RESOURCE MITIGATION GUIDELINE

To protect (*resource value*), activities or surface use will not be allowed (i.e., *within a specific distance of the resource value or between date to date*) in (*legal description*).

Application of this limitation to operation and maintenance of a developed project must be based on environmental analysis of the operational or production aspects.

Exception, waiver, or modification of this limitation in any year may be approved in writing, including documented supporting analysis, by the Authorized Officer.

4.1 Example Resource Categories (*Select or identify category and specific resource value*):

a. Recreation areas.

b. Special natural history or paleontological features.

c. Special management areas.

d. Sections of major rivers.

e. Prior existing rights-of-way.

f. Occupied dwellings.

g. Other (specify).

4.2 Guidance

The SPECIAL RESOURCE MITIGATION GUIDELINE is intended for use only in site-specific situations where one of the first three general mitigation guidelines will not adequately address the concern. The resource value, location, and specific restrictions must be clearly identified. A detailed plan addressing specific mitigation and special restrictions will be required prior to disturbance or development and will become a condition for approval of the permit, plan of development, or other use authorization.

Exception, waiver, or modification of requirements developed from this guideline must be based upon environmental analysis of proposals (e.g., activity plans, plans of development, plans of operation, applications for permit to drill) and, if necessary, must allow for other mitigation to be applied on a site-specific basis.

5.0 NO SURFACE OCCUPANCY GUIDELINE

No Surface Occupancy (NSO) will be allowed on the following described lands (*legal description*) because of (*resource value*).

5.1 Example Resource Categories (*Select or identify category and specific resource value*):

a. Recreation areas (e.g., campgrounds, historic trails, national, monuments).

b. Major reservoirs/dams.

c. Special management areas (e.g., areas of critical environmental concern, known threatened or endangered species habitat, wild and scenic rivers).

d. Other (specify).

5.2 Guidance

The NO SURFACE OCCUPANCY (NSO) MITIGATION GUIDELINE is intended for use only when other mitigation is determined insufficient to adequately protect the public interest and is the only alternative to "no development" or "no leasing." The legal description and resource value of concern must be identified and be tied to an NSO land use planning decision.

Waiver of, or exception(s) to, the NSO requirement will be subject to the same test used to initially justify its imposition. If, upon evaluation of a site-specific proposal, it is found that less restrictive mitigation would adequately protect the public interest or value of concern, then a waiver or exception to the NSO requirement is possible. The record must show that because conditions or uses have changed, less restrictive requirements will protect the public interest. An environmental analysis must be conducted and documented (e.g., environmental assessment, environmental impact statement, etc., as necessary) in order to provide the basis for a waiver or exception to an NSO planning decision. Modification of the NSO requirement will pertain only to refinement or correction of the location(s) to which it applied. If the waiver, exception, or modification is found to be consistent with the intent of the planning decision, it may be granted. If found inconsistent with the intent of the planning decision, a plan amendment would be required before the waiver, exception, or modification could be granted.

When considering the "no development" or "no leasing" option, a rigorous test must be met and fully documented in the record. This test must be based upon stringent standards described in the land use planning document. Since rejection of all development rights is more severe than the most restrictive mitigation requirement, the record must show that consideration was given to development subject to reasonable mitigation, including "no surface occupancy." The record must also show that other mitigation was determined to be insufficient to adequately protect the public interest, a "no development" or "no leasing" decision should not be made solely because it appears that conventional methods of development would be unfeasible, especially where an NSO restriction may be acceptable to a potential permittee. In such cases, the potential permittee should have the opportunity to decide whether or not to go ahead with the proposal (or accept the use authorization), recognizing that an NSO restriction is involved.

APPENDIX B

RECLAMATION RECOMMENDATIONS

RECLAMATION RECOMMENDATIONS

Greater Wamsutter Area II Field Development Project

Prepared by

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January 1995

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APPENDIX B

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RECLAMATION RECOMMENDATIONS

1.0 INTRODUCTION

The following erosion control, revegetation, mitigation measures, and management recommendations are designed to attain successful rehabilitation of disturbed areas associated with the Greater Wamsutter Area II (GWA II) Natural Gas Production project. These recommended measures are designed to establish the feasibility of reclaiming disturbances associated with this project. The recommendations were developed based on 1) Bureau of Land Management (BLM) Wyoming State Office reclamation policy (USDI-BLM 1990), 2) management directives presented in the Great Divide Resource Area Resource Management Plan (RMP) (USDI-BLM 1990), 3) impacts identified in the Environmental Consequences chapter (Chapter 4) of this environmental impact statement (EIS), 4) coordination with BLM staff, and 5) through issues identified during the scoping process. The extent of possible disturbed areas to be reclaimed include the drill sites, access roads and pipeline rights-of-way (ROW), and staging areas. The following measures apply to the Proposed Action and to Action Alternatives A and B unless identified for a specific alternative. The measures presented in this appendix are designed to allow the project to be constructed without significant impacts to natural resources. Because of the large geographic area covered by the project, these measures are presented in a general, non-project specific manner. Final selection of the measures to be applied at any given location, and modifications of these measures, will be identified by the BLM in coordination with UPRC and other Operators.

This appendix provides recommendations only and therefore is ***not*** a reclamation plan. The final reclamation measures that would be applied should be based upon site-specific conditions and validation of these recommendations upon the approval of, and in agreement with, the BLM Authorized Officer (AO). These recommended measures describe how natural gas development activities should be managed to assure compliance with the resource management goals and objectives for the general area, applicable lease and unit area stipulations, and resource limitations identified during interdisciplinary (ID) team analyses. ***If deemed necessary in light of new facts (e.g., effectiveness of specific measures, cost feasibility, and/or availability of materials and supplies, etc.) or to minimize impacts, the following measures may applied where and when needed, added to, modified, or selectively withheld by the Operators in agreement and consultation with the BLM AO.*** Initial monitoring for compliance and successful implementation of the mitigation measures will be under the direction of the operator. Final approval and release will be under the direction of the AO on federally-managed lands.

Reclamation measures covered in this appendix fall into two general categories: temporary and final reclamation. Temporary reclamation refers to measures applied to stabilize disturbed areas and to control runoff and erosion during time periods when application of final reclamation measures is not feasible or practicable. Final reclamation refers to measures that should be applied concurrently with completion of drilling and pipeline installation.

Reclamation potential may be limited by salinity, alkalinity, steep slopes, shallow soils, depth to bedrock, low precipitation, stoniness, high wind and water erosion, periodic flooding, short growing season, seasonably high water tables, and strong winds. Especially intensive land-use practices may be necessary to mitigate salt and sediment loading caused by surface-disturbing activities within the Muddy Creek watershed (USDI-BLM 1990). Activity plans (e.g., applications for permit to drill [APDs]) should address site-specific problems, including monitoring for salt and sediment loading (USDI-BLM 1990).

In general, temporary reclamation measures should be applied to all areas not promptly reclaimed to final conditions within a specified time period whether due to adverse weather conditions, inability to secure needed materials, and/or seasonal constraints, etc. Temporary reclamation measures should be applied only as needed; as in most cases, final reclamation measures should be applied concurrently as sections of the project are completed. Temporary reclamation measures may be applied more rigorously to sensitive areas such as drainage channel crossings, steep slopes, and areas prone to high wind and water erosion. Temporary reclamation measures should include regrading the disturbed area to near predisturbance contour, respreading salvaged topsoil, mulching, and placing runoff and erosion control structures.

Final reclamation measures, in general, involve regrading the disturbed area to near predisturbance contour, respreading salvaged topsoil, applying soil amendments (if necessary), applying a prescribed seed mixture, mulching, and placing runoff and erosion control structures such as water bars and silt fences. The duration of the resultant impacts to the various vegetation community types depends in part on the success of implementation of the reclamation measures prescribed in this appendix and the time required for natural succession to return disturbed areas to predisturbance conditions after project completion.

Because wetlands are "waters of the U.S." and are therefore protected under the federal Clean Water Act (CWA), discharge of dredge or fill material into, and/or excavation of wetlands could require administrative coordination with the U.S. Army Corps of Engineers (COE) pursuant to the CWA and may require a Section 404 permit. The COE, based on the exact nature of the disturbance activity should determine the type of permit (Individual, Regional, or Nationwide) required according to the rules and regulations presented in the Federal Register (1986). Avoidance of waters of the U.S. and wetlands should be the highest priority. A suitable wetland mitigation plan should be developed for the areas of wetlands directly impacted due to project activities where avoidance is not practicable. Impact minimization should include reducing the area of disturbance in wetland areas as well as utilizing procedures specified by authorizing agencies to cross intermittent and ephemeral drainage channels and wetland areas.

Although intermittent and ephemeral drainage channels are not considered wetlands, the same requirements apply to the discharge of dredge and fill into them as for discharge into wetlands. Residual wetland impacts that could occur after maximum avoidance and/or impact minimization has been demonstrated should be mitigated according to the following order of priority: 1) avoidance; 2) impact minimization; 3) mitigation in-kind, on-site; 4) mitigation in-kind, off-site; 5) mitigation out-of-kind, on-site; and 6) mitigation out-of-kind, off-site. In addition, the following modes of mitigation could be implemented for wetland mitigation if avoidance and impact minimization were not feasible: 1) wetlands restoration; 2) wetlands creation; and 3)

wetlands enhancement. The wetlands mitigation plan should be designed to replace the area of impact and functional values associated with the disturbed area.

Appropriate BLM and Soil Conservation Service (SCS) range conservationists were contacted to determine agency-specific seeding recommendations at drill sites and along access road and pipeline ROWs. The recommended seed mixtures in this appendix were developed with input from these land management agencies. The reclamation measures recommended in this report assume that baseline data should be collected in various areas along the access road and pipeline ROWs and at drill sites prior to construction activities by an authorized reclamation scientist, or as directed by the AO.

2.0 OBJECTIVES

This appendix is designed to meet the following objectives for reclamation of the access road/pipeline ROW and the drill sites:

Short-Term (Temporary) Reclamation:

- Immediately stabilize the disturbed areas by mulching, providing runoff and erosion control, and through the establishment of new vegetation (if required).

- Control and minimize surface runoff, erosion, and sedimentation through the use of diversion and water treatment structures.

Long-Term (Final) Reclamation:

- Immediately stabilize the disturbed soil surface by mulching, runoff and erosion control, and through the establishment of new vegetation. Adequate surface roughness should exist to reduce runoff and to capture rainfall and snow melt.

- Control and minimize surface runoff, erosion, and sedimentation through the use of diversion and water treatment structures.

- Restore primary productivity of the site and establish vegetation that will provide for natural plant and community succession.

- Establish a vigorous stand of desirable plant species that will limit or preclude invasion of undesirable species, including noxious weeds.
- Revegetate the disturbed areas with plant species useful to wildlife and livestock.
- Enhance aesthetic values. In the long-term, reclaimed landscapes should have characteristics that approximate the visual quality of adjacent areas, including location, scale, shape, color, and orientation of major landscape features.

3.0 PERFORMANCE STANDARDS

The following performance standards should be used to determine the attainment of successful revegetation:

<u>All Years:</u>

- <u>Protective cover</u> - with the exception of active work areas, all disturbed highly erosive or sensitive areas to be left bare, unprotected, or unreclaimed for more than one month will have at least a 50 percent cover of protective material in the form of mulch, matting, or vegetative growth. All disturbed areas should have at least a 50 percent cover of protective material within six months.

<u>Second Year (Final Reclamation):</u>

- <u>Seedling density</u> - the density and abundance of desirable species is at least three to four seedlings per linear foot of drill row (if drilled) or transect (if broadcast). Vegetative transects will be established on a permanent basis so that transects can be measured annually through the five year monitoring period.
- <u>Percent cover</u> - total vegetal cover will be at least 50 percent of predisturbance vegetal cover as measured along the reference transect for establishing baseline conditions.

<u>By the Fifth Year (Final Reclamation):</u>

- <u>Percent cover</u> - total vegetal cover will be at least 80 percent of predisturbance vegetal cover as measured along the reference transect for establishing baseline conditions.
- <u>Dominant species</u> - 90 percent of the revegetation consists of species included in the seed mix and/or occurs in the surrounding natural vegetation, or as deemed

desirable by the BLM as measured along the reference transect for establishing baseline conditions.

- Erosion condition/soil surface factor - erosion condition of the reclaimed areas is equal to or in better condition than that measured for the reference transect for establishing baseline conditions.

4.0 METHODS

4.1 Drill Site, Access Road, and Pipeline Right-of-Way Clearing and Topsoil Removal and Storage

Topsoil should be handled separately from subsoil materials. At all construction sites, topsoil should be stripped to provide for sufficient quantities to be respread to a depth of at least four to six inches over the disturbed areas to be reclaimed. In areas where deep soils exist (such as floodplains and drainage channel terraces), at least 12 inches of topsoil should be salvaged. Where soils are shallow to bedrock or have a stony subsoil, topsoil should be salvaged as specified by the AO. Topsoil should be stockpiled separately from subsoil materials. Topsoil salvaged from drill sites and stored for more than one year should be bladed to a specified location at these areas, seeded with a prescribed seed mixture, and covered with mulch for protection from wind and water erosion and to discourage the invasion of weeds. Topsoil should be stockpiled separately from other earth materials to preclude contamination or mixing and should be marked with signs and identified on Construction and Design plans. Runoff should be diverted around topsoil stockpiles to minimize erosion of topsoil materials. In most cases, disturbances will be reclaimed within one year. Therefore, it is unlikely that topsoil stockpiling for more than one year will be required. Salvaged topsoil from roads and drill sites will be respread over cut-and-fill surfaces not actively used during the production phase. Upon final reclamation at the end of the project life, topsoil spread on these surfaces will be used for the overall reclamation effort.

Operators are finding out that it is not always necessary to remove all vegetation and strip all topsoil within a pipeline ROW. In many areas, such as with deep soils on relatively flat smooth slopes with low gradients, it is possible to crush in-place rather than clear vegetation and leave topsoil in-place rather than blade and stockpile. This technique would reduce the magnitude and severity of disturbance impacts and hasten successful reclamation.

In federal jurisdictional wetland areas, vegetation should be cut off only to the ground level, leaving existing root systems intact. Cut vegetation should be removed from wetland areas for disposal. Grading activities should be limited to directly over pipeline trenches and access roads. At least 12 inches of topsoil should be salvaged and replaced except in areas with standing water or saturated soils. Use of construction equipment in wetland areas should be limited. Dirt, rockfill, or brush riprap should not be used to stabilize pipeline ROWs. If standing water or saturated soils are present, wide-track or balloon-tire construction equipment should be used or normal construction equipment should be operated on equipment pads or geotextile fabric overlain with gravel fill. Equipment pads etc., should be removed immediately upon completion of construction activities. Trench spoil should be placed at least 10 feet away from drainage channel banks for all minor and major drainage channel crossings.

4.2 Drill Site, Access Road, and Pipeline Right-of-Way Construction

4.2.1 Upland Areas

Construction should be accomplished following site-specific Construction and Design plans and applicable agency specifications. At drill sites, and along the areas of access road or pipeline ROW traversing steep slopes, slope angles should be minimized to enhance retention of topsoil, and reduce erosion as well as facilitate revegetation, and subsequent reclamation success. Slope stabilizing revetment structures may be necessary in areas where the substrata materials are unconsolidated and loose and cannot be stabilized with revegetation and mulch.

Surface runoff should be controlled at all well sites through the use of interception ditches and berms. A berm approximately 18 inches high should be constructed around fill portions of these well sites to control and contain all surface runoff generated or fuel or petroleum product spills on the pad surface. Water contained on the drill pads should be treated in a detention pond prior to discharge into undisturbed areas in the same manner as discussed previously. This system should also serve to capture fuel and chemical spills, should they occur.

Erosion and sedimentation control measures and structures, as approved by the AO, should be installed on all disturbed areas. Soil erosion control should be accomplished on sites in highly erosive soils and steep areas with mulching, netting, tackifiers, hydromulch, matting, and excelsior. The type of control measure should depend on slope gradients and the susceptibility of soil to wind and water erosion. Silt fences should be placed at the base of all steep fill slopes and sensitive disturbed areas. All runoff and erosion control structures should be inspected periodically, cleaned out, and maintained in functional condition throughout the duration of construction and drilling. Water bars should be constructed on cut-and-fill slopes exceeding 25 feet long and 10 percent gradient using the water bar spacing guidelines and procedures specified for access road and pipeline ROW runoff and erosion control.

Runoff and erosion control along access road/pipeline ROWs should be accomplished by implementing standard cross drain, culvert, road ditch, and turnout design as well as timely mulching and revegetation of exposed cut, fill, and road shoulders. All culverts should be constructed with riprapped entrances and exits and with energy dissipators or other scour-reducing techniques where appropriate. Water discharged from culverts, cross drains, road ditches and turnouts should be directed into undisturbed vegetation away from all natural drainages.

Erosion and sedimentation control measures and structures, as approved by the AO, should be installed across all cut-and-fill slopes within 100 feet of drainage channels. All runoff and erosion control structures should be inspected after major runoff events and at a regular schedule. If found to be sub-standard, these structures should be cleaned out and maintained in functional condition throughout the life of the project.

4.2.2 Drainage Channel Crossings

Construction of drainage channel crossings should minimize the disturbance to drainage channels and wetlands to the extent practicable and should occur during the low runoff period (June 15 through March 1), or as directed by the AO. Staging areas should be limited in size to the minimum necessary and should be located at least 50 feet from drainage channel bottoms, where topographic conditions permit. Hazardous materials should not be stored and equipment should not be refueled within 100 feet of drainage channels. Drainage channel crossings should be constructed as perpendicular to the axis of the drainage channel and at the narrowest positions as engineering and routing conditions permit. Clean gravel should be used for the upper one foot of fill over the backfilled pipeline trenches.

4.2.3 Wetlands

Access roads and pipelines should be rerouted, and drill sites located, to avoid wetland areas to the maximum extent practicable. The size of staging areas should be limited to the minimum necessary and all staging areas should be located at least 50 feet from the edge of federally delineated wetland areas, where topographic conditions permit. The width of the access road and pipeline construction ROW should be limited to no more than 50 feet. Hazardous materials should not be stored and equipment should not be refueled within 100 feet of wetland boundaries. Appropriate permits should be secured from the COE prior to any construction activities in federal jurisdictional wetland areas.

4.3 Surface Runoff and Erosion Control

4.3.1 Drill Site, Access Road, and Pipeline Right-of-Way

4.3.1.1 Temporary Reclamation

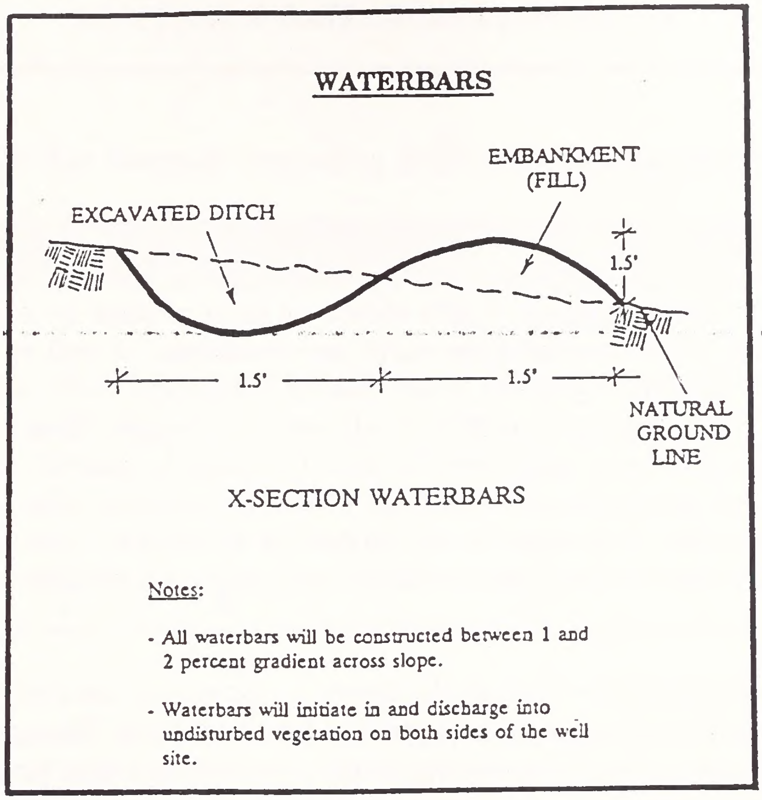
Temporary erosion control measures may include application of mulch and netting of biodegradable erosion control blankets stapled firmly to the soil surface, respreading scalped vegetation, construction of water bars, or other procedures as directed by the AO. See Final Reclamation measures for specific information pertaining to mulching.

The actual distance of a pipeline/road ROW requiring stabilization on each side of a drainage channel should be determined on a site-specific basis as directed by the AO. To minimize sedimentation of drainage channels and wetlands during the interim period between construction activity and final reclamation, temporary erosion and sediment control measures should be applied. Silt fences or other sediment filtering devices such as weed-free straw bales should be installed at drainage channel banks where sedimentation is excessive and at the base of all slopes adjacent to wetlands. Exhibit B-1 presents schematics of water bar and silt fence construction. Sediment filtering devices should be cleaned out and maintained in functional condition throughout the life of the project. To avoid the possibility of mulching materials entering waterways, loose mulch (i.e., mulch not crimped into the soil surface, tackified, or incorporated into erosion control blankets) should not be applied to drainage channel banks.

If construction is completed more than 30 days prior to the specified seeding season for perennial vegetation, areas adjacent to the larger drainage channels should be covered with jute matting for a minimum of 50 feet on either side of the drainage channel. In addition, to protect soil from raindrop impact and subsequent erosion, 2.0 tons/acre of a weed-free straw mulch should be applied to all slopes greater than 10 percent. Temporary erosion control measures may include leaving the ROW in a roughened condition, respreading scalped vegetation, or applying mulch as specified by the AO. As indicated by several operators and the BLM, weed-free straw mulch is difficult to obtain in quantities and at costs suitable for all reclamation applications. Although this circumstance could reduce the application of the measure, the effectiveness of mulch in protecting the exposed soil from raindrop impact, erosion, and off-site sedimentation should not be ignored. As discussed in the Soils and Water Resources Technical Report (ECOTONE 1994), the effective application of mulch can reduce soil erosion by as much as 900 percent. In addition to its effectiveness in erosion control, mulching also benefits the soil as a plant growth medium in many cases. Therefore, effective mulching is fundamental to reducing soil erosion to acceptable, non-significant levels.

Trench breakers should be used for pipeline construction in certain areas to prevent the flow of water in either a trench that has been backfilled or temporarily left open. Trench breakers are particularly important in wetland areas to minimize subsurface drainage. Trench breakers should be constructed such that the bottom of one breaker is at the same elevation as the top of the next breaker down slope, or every 50 feet, whichever is greater. Factors that control the application of trench breakers include the proximity to drainage channels and wetland areas, slope gradient, proximity of areas to shallow groundwater, and surface runoff source areas that can discharge water into the trench. Trench breakers should be installed, where necessary, as directed by the AO. Topsoil should not be used to construct trench breakers.

If a pipeline crosses roads at the base of slopes, vegetative strips should be maintained. If vegetation is disturbed within these limits, temporary sediment barriers such as silt fences and/or staked weed-free straw bales should be installed at the base of the slope adjacent to the road crossing. Temporary sediment barriers should remain in-place until permanent revegetation measures have been judged successful by the AO.



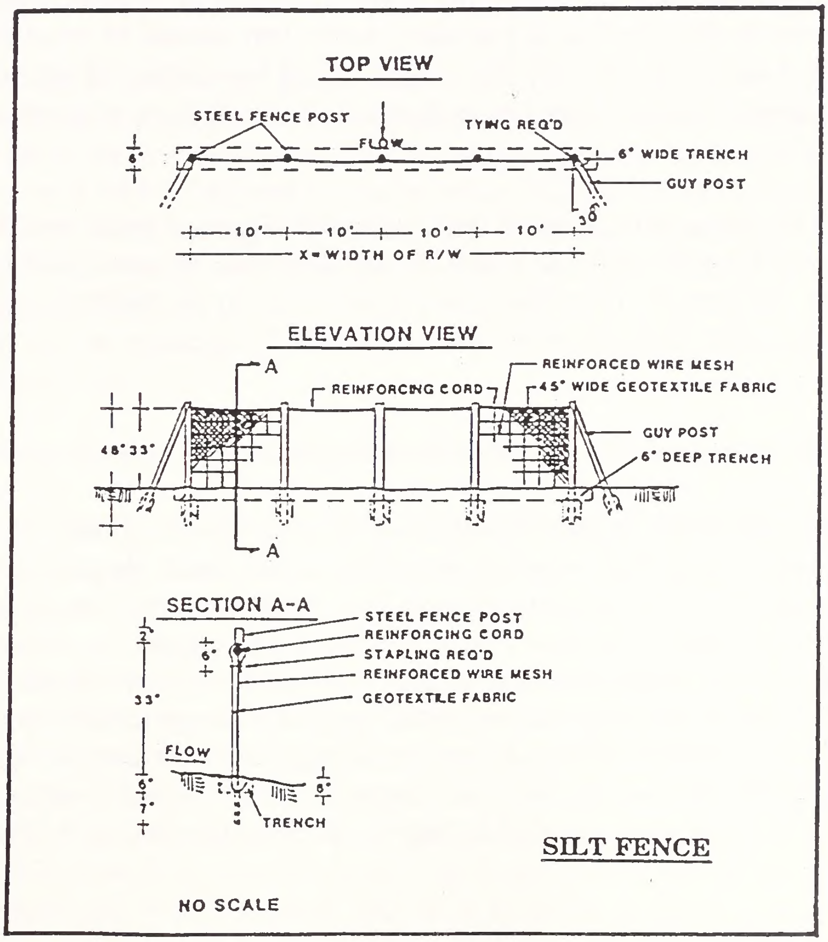


Exhibit B-1. Water Bar Construction and Silt Fence Construction.

4.3.1.2 Final Reclamation

4.3.1.2.1 Upland Areas

Runoff and erosion control along all ROWs should be accomplished by constructing sediment trapping devices (e.g., silt fences and straw bales) and water bars, as well as by timely mulching and revegetation of exposed disturbed areas. Runoff discharged from water bars should be directed into undisturbed vegetation away from all natural drainages. Erosion and sedimentation control measures and structures, as approved by the AO, should be installed across all cut-and-fill slopes. All runoff and erosion control structures should be inspected after major runoff events and at a regular schedule. If found to be substandard or ineffective, these structures should be cleaned out and maintained in functional condition until successful revegetation and soil stability is attained.

Water bars should be constructed across sideslopes at appropriate intervals according to slope gradient immediately following recontouring of the disturbed areas. The spacing should depend on whether mulching is applied in conjunction with placement of water bars. Water bars should be maintained in functional condition throughout the life of the project. Should the integrity of the water bar system be disrupted during seeding, water bars should be repaired and broadcast seeded with the seed raked into the soil. Water bars should be constructed according to hillslope topography at the slope gradient intervals as shown in Table B-1, or as directed by the AO or landowner.

Water bars should be constructed 12 to 18 inches deep by digging a small trench and casting the soil material to the downhill side in a row. Each water bar should initiate an undisturbed vegetation upslope, traverse the disturbed area perpendicular to the ROW at a gradient between one and two percent, and discharge water into undisturbed vegetation on the lower side of the disturbed area.

4.3.1.2.2 Wetlands and Drainage Channel Crossings

Disturbance to the ephemeral and intermittent drainage channels should be avoided and/or minimized. All channel crossings not maintained for access roads should be restored to near predisturbance conditions. Drainage channel bank slope gradients should be regraded to conform with adjacent slope gradients. Channel crossings should be designed to minimize changes in channel geometry and subsequent changes in flow hydraulics. Culverts should be installed for ephemeral and intermittent drainage channel crossings. All drainage channel crossing structures should be designed to carry the 25- to 50-year discharge event as directed by the BLM. Silt fences should be constructed at the base of slopes at all drainage channel crossings. Minor routing variations should be implemented during access road, pipeline, and drill site layout to

Table B-1. Water Bar Intervals According to Slope Gradient[1].

With Mulching		Without Mulching	
Slope Gradient (percent)	**Interval (feet)**	**Slope Gradient (percent)**	**Interval (feet)**
10	150	10	100
15	100	15	75
20	50	20	45
30	40	30	40
40	35	40	35
50	30	50	30
>50	30	>50	30

[1] - Based on Grah (1989).

avoid washes. The area of disturbance in the vicinity of washes should be minimized. Per the Great Divide Resource Area Resource Management Plan (RMP), a 500-foot-wide buffer strip of natural vegetation should be maintained between all construction activities and drainage channels.

Trench plugs should be employed at non-flumed drainage crossings to prevent diversion of drainage channel flows into upland portions of pipeline trenches during construction. Application of riprap should be limited to areas where flow conditions prevent vegetative stabilization; riprap activities must comply with COE permit requirements. Pipeline trenches should be dewatered in such a manner that no silt laden water flows into active drainage channels (i.e., prior to discharge the water should be filtered through a silt fence, weed-free straw bales, or allowed to settle in a sediment detention pond).

4.4 Final Reclamation

4.4.1 Topsoil Respreading and Seedbed Preparation

In preparation for seeding, at least four to six inches of topsoil should be evenly respread over the pipeline ROW, staging areas, cut-and-fill surfaces, and all areas of other sites not required for production purposes.

Soil compaction could result from heavy equipment working on disturbed soils prior to revegetation. Therefore, compaction is likely to occur under most situations. Soil compaction can inhibit adequate revegetation of disturbances. Therefore, all disturbances to be revegetated will be ripped to reduce the adverse effect of compaction. A spring tooth harrow equipped with utility or seedbed teeth, or ripper-teeth equipment mounted behind a large crawler tractor or patrol, as directed by the AO, should be used to loosen the subsoil. The subsoil surface should be left rough. After topsoil has been respread and if it is loose, it should be compacted with a cultipacker or similar implement to provide a firm seedbed. On steep slopes (greater than 40 percent and highly erosive), it may be difficult or impossible to replace topsoil and adequately prepare the seedbed. All disturbed areas should be ripped on 18- to 26-inch spacing and 12 to 16 inches deep. These areas should then be mulched with a hydromulch/seed/tackifier mix. If implemented, erosion control blankets with seed incorporated into the matting should be installed per manufacturer's specifications to enhance soil stabilization.

4.4.2 Seed Application

All disturbed areas should be seeded immediately following the final grading of the topsoil to the approximate original contour, weather permitting. The seedbed should be prepared to a depth of three to four inches where possible to provide a firm seedbed. If hydroseeding or broadcast seeding is employed, the seedbed should be scarified to ensure good seed-soil contact. After completion of seedbed preparation, the seed mixtures presented in Tables B-2 through B-5, or a similar mix, as directed by the AO, should be applied according to the pure live seed (PLS) rates and drilling depths specified, to areas along the road and pipeline ROW, staging areas, and unused areas of drill sites that have been retopsoiled.

Seed should be used within 12 months of viability testing. Legume species purchased commercially must have been properly inoculated with nitrogen-fixing bacteria. Seed should be planted in the fall (after September 31) or no later than late fall (mid-November) prior to snow accumulation to avoid seed germination and breaking of dormancy and to prevent seedling frost damage; or in early Spring (prior to May 15); or as directed by the AO. Seed should preferably be planted with drill-type of equipment such as a rangeland drill or brillion seeder. Where the microtopography of the disturbed areas does not allow drill-type equipment, seed should be broadcast applied at twice the application rate of drilled seed. A spike-toothed harrow or similar equipment should be used where ripping has been insufficient to provide cover for the broadcast seed.

Any soil disturbance that occurs outside the recommended permanent seeding season, or any bare soil left unstabilized by vegetation, should be treated as a winter-construction problem and mulching should be considered, or the site stabilized and/or other actions taken as otherwise directed by the AO.

The seed mixtures presented in Tables B-2 through B-5, or similar mixtures as specified by the AO, should be applied according to specific areas identified to be homogeneous in terms of overall ecosystem similarities such as precipitation zones, elevational zones, dominant species herbaceous cover, soil types, and inherent limitations in reclamation success potential. Specifically, Seed Mixture #1 (Table B-2) should be applied to disturbances in the sagebrush-dominated mixed desert shrub and Juniper woodland community types. Seed Mixture #2 (Table B-3) should be applied to disturbances in the more moist alkaline mixed desert shrub community types. Seed Mixture #3 (Table B-4) should be applied to greasewood-dominated mixed desert

Table B-2. Seed Mixture[1] #1 - Sagebrush-Dominated Mixed Desert Shrub Community Types.

Species	Cultivar or Variety	Seed Application Drilled Rate (pls[2] lbs/ac)	Planting Depth (if drilled) (inches)
Grasses			
Western wheatgrass (*Agropyron smithii*)	Rosanna	2.0	0.5
Bluebunch wheatgrass (*Agropyron spicatum*)	Secar	2.0	0.5
Bottlebrush squirreltail (*Sitanion hystrix*)	-	2.0	0.5
Indian ricegrass (*Oryzopsis hymenoides*)	Nezpar	2.0	0.5
Needle-and-Thread (*Stipa comata*)	-	2.0	0.5
Forbs			
Gooseberryleaf globemallow (*Sphaeralcea grossulariaefolia*)	-	1.0	0.5
Cicer milkvetch (*Astragalus cicer*)	Monarch	1.0	0.5
Shrubs			
Wyoming big sagebrush (*Artemisia tridentata*)	-	2.0	0.25
Antelope bitterbrush (*Purshia tridentata*)	-	1.0	0.5
Fourwing saltbush (*Atriplex canescens*)	-	1.0	0.5
TOTAL		**14.5**	

[1] Seed mix based on adaptation to the site conditions of the project, usefulness of species for rapid site stabilization, species success in revegetation efforts, and current seed availability and cost.

[2] PLS = pure live seed.

Table B-3. Seed Mixture[1] #2 - Moist Alkaline Areas in the Mixed Desert Shrub Community Type.

Species	Cultivar or Variety	Seed Application Drilled Rate (pls[2] lbs/ac)	Planting Depth (if drilled) (inches)
Grasses			
Spike Muhly (*Muhlenbergia wrightii*)	El Vado	2.0	0.5
Alkaligrass (*Pucinellia distans*)	Fults	5.0	0.5
Alkali sacaton (*Sporobolus airoides*)	Salado	3.0	0.5
Forbs			
Strawberry clover (*Trifolium fragiferum*)	O'Connors, Salina	2.0	0.5
Shrubs			
Fourwing saltbush (*Atriplex canescens*)	-	1.0	0.5
Shadscale (*Atriplex confertifolia*)	-	1.0	0.5
TOTAL		**14.0**	

[1] Seed mix based on adaptation to the site conditions of the project, usefulness of species for rapid site stabilization, species success in revegetation efforts, and current seed availability and cost.

[2] PLS = pure live seed.

Table B-4. Seed Mixture[1] #3 - Greasewood-Dominated Valley Bottoms and Bluffs.

Species	Cultivar or Variety	Seed Application Drilled Rate (pls[2] lbs/ac)	Planting Depth (if drilled) (inches)
Grasses			
Western wheatgrass (*Agropyron smithii*)	Rosanna	3.0	0.5
Pubescent wheatgrass (*Agropyron tricophorum*)	Luna	2.0	0.5
Alkali sacaton (*Sporobolus airoides*)	-	2.0	0.25
Russian wildrye (*Elymus junceus*)	Vinall	2.0	0.25
Forbs			
Cicer milkvetch (*Astragalus cicer*)	Monarch	3.0	0.5
Shrubs			
Fourwing saltbush (*Atriplex canescens*)	-	1.0	0.5
Gardner saltbush (*Atriplex gardneri*)	-	1.0	0.5
Winterfat (*Ceratoides lanata*)	-	1.0	0.5
TOTAL		**15.0**	

[1] Seed mix based on adaptation to the site conditions of the project, usefulness of species for rapid site stabilization, species success in revegetation efforts, and current seed availability and cost.

[2] PLS = pure live seed.

Table B-5. Seed Mixture[1] #4 - Wet Meadow Community Types.

Species	Cultivar or Variety	Seed Application Drilled Rate (pls[2] lbs/ac)	Planting Depth (if drilled) (inches)
Grasses			
Spike muhly (*Muhlenbergia wrightii*)	El Vado	2.0	0.5
Redtop (*Agrostis alba*)	-	1.0	0.5
Tufted hairgrass (*Deschampsia cespitosa*)	-	4.0	0.25
Forbs			
Red clover (*Trifolium pratense*)	Kenland	2.0	0.5
Strawberry clover (*Trifolium fragiferum*)	O'Connors, Salina	2.0	0.5
TOTAL		**13.0**	

[1] Seed mix based on adaptation to the site conditions of the project, usefulness of species for rapid site stabilization, species success in revegetation efforts, and current seed availability and cost.

[2] PLS = pure live seed.

shrub communities in alkaline valley bottoms and bluffs. Seed Mixture #4 (Table B-5) should be applied to disturbances in wet meadow community types. These seed mixes were developed based on the following criteria: 1) site-specific conditions of the analysis area; 2) usefulness of species in rapid site stabilization; 3) species success in revegetation efforts; and 4) current seed costs and availability. In general, native species are preferred to introduced species unless 1) an introduced species has been documented to better meet specific revegetation objectives, or 2) areas exist that are already covered by marginally desirable introduced species such as crested wheatgrass (*Agropyron cristatum*). Final seed mixes applied in the revegetation effort should be designed in coordination with the BLM.

Final determination of the appropriate seed mixture should be developed on a site-specific basis at the time of field review of the facility. Seeding rates may be varied to enhance the probability for maintaining the natural balance of species. Watershed protection must be emphasized when reclaiming disturbed areas. The composition of rare and native species, if encountered, should be taken into consideration at the time of seeding; however, appropriate measures must be taken to ensure that an adequate protection of the soil surface is obtained. Areas not exhibiting successful revegetation throughout the entire area disturbed by the project (as determined by the AO or Environmental Inspector), should be reseeded until an adequate cover of vegetation is established.

Private and agricultural lands should be seeded according to the landowner's request. Should the landowner not specify a recommended seed mixture, the AO should determine the appropriate seed mixture to apply.

4.4.3 Mulching

In sensitive sites where significant erosion (e.g., large areas of disturbance or areas with high erosion rates) is most likely to occur, the seeded access road/pipeline ROW, staging areas, and the portion of the drill pads not needed for production purposes should be mulched following seeding to protect the soil from wind and water erosion, raindrop impact, surface runoff, and noxious weed invasion, and to hold the seed in place. The exposed surface of disturbed areas, including topsoil stockpiles, may be protected by placing crimped straw mulch, hydromulch, biodegradable plastic netting and matting, or biodegradable erosion control blankets.

All sensitive disturbed areas should be mulched immediately following seeding with 1.5 to 2.0 tons/acre of a weed-free straw mulch. Mulching materials should be reasonably free of noxious and undesirable plant species as defined by state or county lists. Hay mulch may be used, but it should be applied only if cost-competitive and if crimped into the soil. Straw mulch is more desirable than hay mulch because it is generally less palatable to feral horses, wildlife, and livestock. Additionally, there tends to be a higher risk of introducing undesirable species and noxious weeds with a hay mulch such as smooth brome, timothy, orchardgrass and other minor species. The lessee should maintain all disturbances relatively weed-free for the life of the project through implementation of a noxious weed monitoring and eradication program.

Wherever utilized, mulch should be spread uniformly so that at least 75 percent of the soil surface is covered. If a mulch blower is used, the straw strands should not be shredded less than eight inches in length to allow effective anchoring. On slopes less than 30 percent, straw mulch should be applied by a mechanical mulch blower at a rate of 2.0 tons/acre after seeding. The mulch should be crimped into the soil surface using a serrated disc crimper or similar implement as directed by the AO. Where broadcast straw mulch is applied on windswept slopes, a biodegradable plastic netting should be staked firmly to the soil surface over the mulch following the manufacturer's specifications. On slopes in excess of 40 percent or on slopes exceeding the operating capabilities of machinery, hydromulch or biodegradable erosion control blankets with seed incorporated into the netting should be applied and staked firmly to the soil surface.

Where utilized, hydromulch and tackifier should be applied at a rate of 1,500 lbs/acre or as otherwise approved by the AO. In general, erosion control and soil stabilization are directly related to the amount of mulch applied. Under certain conditions where degradation processes are slow (e.g., in extremely hot or cold dry climates), a trade-off between the degree of effectiveness of mulch and long-term degradation should be considered. In extremely dry areas where mulch degradation may be slow, mulching rates should be reduced to 1.0 to 1.5 tons/acre or as specified by the AO. Special measures may need to be implemented in areas with sandy soils.

On steeper slopes with highly erodible, shallow, rocky soils and/or on windswept areas with loose, unconsolidated materials, the above recommended measures may not be sufficient to reduce erosion to non-significant levels. The following measure should be considered by the operator and the BLM to stabilize such sites: incorporating a custom blend of seed into erosion control blankets. This method has proven cost-effective in many cases, with 98 percent of the cost being the blanket itself. The additional cost of incorporating seed into the blanket will average $1.00 to $1.50 per blanket, depending upon current seed costs. In most cases, this additional cost should offset the repeated efforts of broadcast seeding, manual raking of seeds into the soil, and mobilizing a labor force. The AO should determine the final measure(s) to be implemented in such areas.

4.4.4 Livestock Control

Livestock grazing should be monitored along all areas of drill sites and access road and pipeline ROW. Should grazing negatively impact revegetation success, measures should be taken to immediately remove livestock from the newly reclaimed areas. Depending upon site-specific evaluations, it may be necessary to temporarily fence off certain riparian areas and wetlands to prevent excessive livestock grazing and trampling to enhance drainage channel bank stabilization and overall revegetation success. Existing livestock control structures such as fences and cattleguards should be maintained in functional condition during all phases of the project. Where access requires the disruption of an existing fence, a cattleguard should be installed at the juncture.

4.4.5 Off-Road Vehicle Control

Off-road vehicle control measures should be installed and maintained as specified by the AO and landowners following the completion of seeding. Examples of practicable measures include a locking, heavy steel gate with fencing extending a reasonable distance to prevent bypassing the gate, with appropriate signs posted; a slash and timber barrier; a pipe barrier; a line of boulders; or signs posted at all points of access at intervals not to exceed 2,000 feet indicating "This Area Seeded for Wildlife Benefits and Erosion Control."

4.4.6 Fugitive Dust Control

Should fugitive dust generated during construction of the drill sites, access road/pipeline ROWs, or staging areas become a problem, dust abatement measures should be implemented. Such procedures should be determined by the AO and could include applying water or water with additives (e.g., magnesium chloride) to the construction area at regular intervals, or as directed by the AO.

4.5 Monitoring and Maintenance

4.5.1 General

A designated official or responsible party should annually inspect and review the condition of all drill sites, access road/pipeline ROWs, and any other disturbed areas associated with the Greater Wamsutter Area II Natural Gas Production project. This official should assess the success of and prognosis for all runoff and erosion control and revegetation efforts, evaluate fugitive dust control needs, and recommend remediation measures, if necessary. In addition, monitoring should take place following each major runoff event. Photographs should be taken at drill sites and along access roads at specific areas each year to document the progress of the reclamation program at established photomonitoring points.

The following specific items should be monitored during inspections:

- revegetation success;
- sheet and rill erosion, gullies, slumping, and subsidence;
- soundness and effectiveness of erosion control measures;
- sediment filtering devices along all active ephemeral and intermittent drainage channels;
- water quality and quantity;
- noxious weed invasion;
- degree of rodent damage on seed and seedlings;
- locations of unauthorized off-highway vehicle (OHV) access;
- soundness and effectiveness of OHV control structures;

- evidence of livestock or wildlife grazing; and
- overgrazing/trampling of riparian and wetland areas.

4.5.2 Reclamation Success Monitoring

Reclamation success should be based upon the objectives specified in this appendix; therefore, monitoring should be tied to these objectives. The actual monitoring procedures for quantitative and qualitative evaluations of reclamation success should be implemented as specified by the BLM or other authorizing agencies.

Reclamation success should be monitored both in the short term (temporary reclamation) and in the long term (final reclamation). Monitoring of temporary reclamation measures should include visual observations of soil stability, condition, and effectiveness of mulching and runoff and erosion control measures and a quantitative and qualitative evaluation of revegetation success, where appropriate. Long-term reclamation monitoring should include visual observations of soil stability, condition of the effectiveness of mulching and runoff and erosion control measures, and a quantitative and qualitative evaluation of revegetation success.

Revegetation success should be determined through monitoring and evaluation of percent ground cover to include a measure of vegetal cover (by species), litter/mulch, rock/gravel, and bare ground. Ground cover should be documented at each 1-foot interval along a 100-foot line intercept transect. Seedling density and relative abundance should be determined by selection of plots at the 20-, 40-, 60-, and 80-foot marks on the transect. Grazing impacts should be assessed as an ocular estimate of the percent utilization along the transect.

Soil stability should be measured using an erosion condition class/soil surface factor rating method to numerically rate soil movement, surface litter, surface rock, pedestalling, flow patterns, and rill-gully formation. Information obtained through this rating system represents an expression of current erosion activity and can be used to reflect revegetation success as a function of soil stability.

The access road boundaries, pipelines, and unused portions of the drill sites should be monitored until released by the AO upon attainment of 80 percent of predisturbance vegetative cover within five years of seeding. This standard should include 90 percent of the vegetative cover being comprised of desirable species and the erosion condition of the reclaimed area being equal to or in better condition than predisturbance conditions as prescribed under the Performance Standard section of this appendix.

4.5.3 Wetland and Drainage Channel Crossings

Wetland areas and natural drainage channel crossings should be monitored for a minimum of three years for noxious weed invasion and establishment of undesirable species. Noxious weeds should not be allowed to establish at any time. If found in a reclaimed wetland or drainage channel crossing, the noxious weeds should be removed. Undesirable species should not be allowed to establish. At the third year of monitoring, undesirable species should comprise no more than 15 percent of the total vegetation cover. The lessee should maintain wetland areas and drainage channel crossings according to this standard throughout the development of a noxious weed and undesirable species monitoring and eradication program.

4.5.4 Photomonitoring

Permanent photomonitoring points should be established at appropriate vantage locations that provide adequate visual access to drill sites, along pipeline and access road rights-of-way, and to ancillary facilities. Each photomonitoring point should be permanently marked with re-bar and identified on a topographic map of the area. The location of each point should be described in detail to assist in relocation from year to year. Photos should be taken at each photomonitoring point prior to initiation of construction. Photos, framing the same scene as previously taken, should be taken each year until reclamation standards have been met. These photographs should be included in a yearly report submitted to the BLM and other interested agencies.

5.0 REFERENCES CITED

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APPENDIX C

APPENDIX C.1

MASTER SURFACE USE AND OPERATING PLAN

APPENDIX C.2

MASTER DRILLING PLAN

APPENDIX C.1

MASTER SURFACE USE AND OPERATING PLAN

GREATER WAMSUTTER AREA II NATURAL GAS PRODUCTION PROJECT

1.0 ROADS

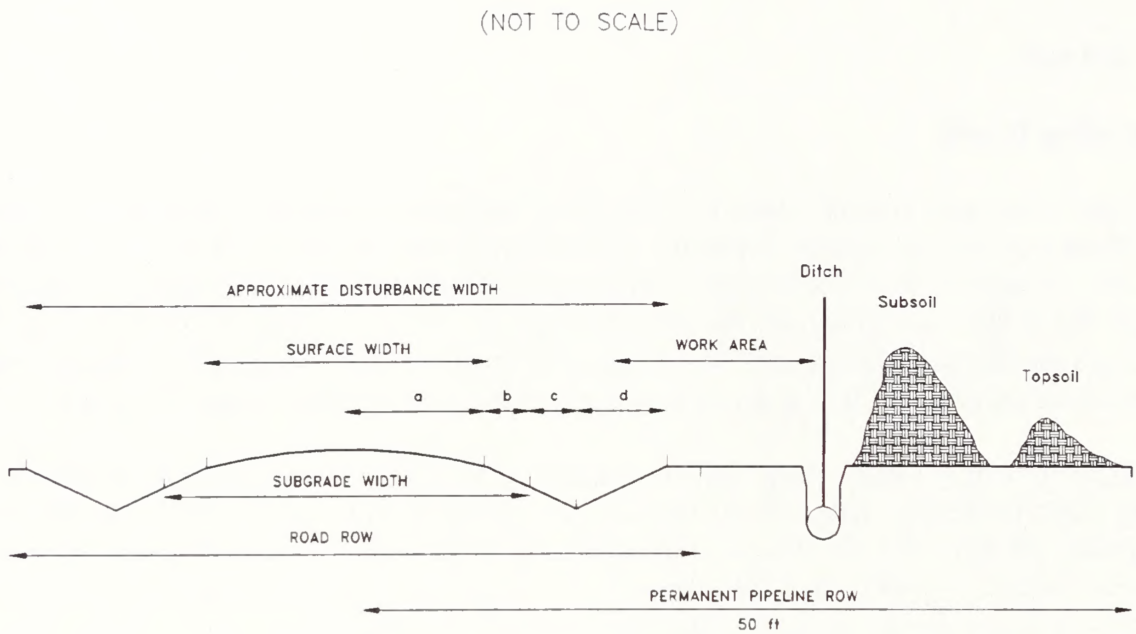
1.1 Existing Roads

The Greater Wamsutter Analysis Area II (GWA II) is located in southeastern Sweetwater County and southwestern Carbon County, Wyoming, within Townships 16 through 21 North (T16-21N), Ranges 92 through 95 West (R92-95W), 6th Principal Meridian. The GWA II is accessed by Interstate 80 (I-80), which crosses the north-half of the analysis area (Exhibit C-1), and by Wyoming State Highway 789, located to the east of the analysis area. Numerous secondary roads resulting from previous drilling and production activities also traverse through the GWA II.

All existing, privately owned roads will be maintained in their present condition or improved. Existing roads located on public lands will be maintained as required by the Bureau of Land Management (BLM). If multiple operators are utilizing the same road network, Union Pacific Resources Company (UPRC) and the other operators will enter into an operations maintenance agreement to establish the standards and timing of road maintenance.

1.2 Access Roads to be Constructed or Reconstructed

Access road construction on public lands will be in accordance with BLM Manual standards (USDI-BLM Manual 9113) and shown in access road design plans submitted with the individual drill site application for permit to drill (APD). (Refer to Attachment 1 for a typical road cross section for road construction in the GWA II.) The roadbed subgrade will be scarified for its full width and to a depth sufficient to eliminate surface irregularities. The scarified surface will then be bladed and shaped to the lines, grades, dimensions, and typical cross section shown on Attachment 1. Compaction of scarified material as bladed and shaped in accordance with these specifications will be achieved by routing construction equipment over the full width of the roadbed. Surfacing will be designed to accommodate anticipated loading and traffic volumes and shall provide for future maintenances. The total width of the right-of-way (ROW), after upgrading, will be no greater than 50 feet. If width of disturbance greater than 50 feet is needed for a particular road segment, it will be discussed in the individual APD pertaining to that road. After construction is completed, all disturbed areas beyond the road and drainage ditches will be recontoured to conform to the local topography as much as possible. Reclamation procedures will follow the guidelines set in the Reclamation Recommendation, Appendix B of the project environmental impact statement (EIS). Locations of existing roads and proposed new roads are shown in Attachment 2, the Infill Program (located in the map pocket).



	MINIMUM SUBGRADE WIDTH (ft)	MINIMUM SURFACED TRAVELWAY WIDTH (ft)	a (ft)	b (ft)	c (ft)	d (ft)	APPROXIMATE DISTURBANCE WIDTH (ft)	TOTAL ROW WIDTH (ft)	DESIGN SPEED (mph)
RESOURCE ROAD	16	12	6	2	4	8	40	50	15–30
LOCAL ROAD	24	20	10	2	4	8	48	55	20–50
COLLECTOR ROAD	28	24	12	2	4	8	52	60	30–50

Exhibit C-1. Typical Road Cross-Section.

- Maximum Grades. Grades will be held to 8 percent or less, unless specifically discussed in the individual APD.

- Major Cuts and Fills. No major cuts and fills are anticipated; however, if they are encountered, they will be discussed in the APD for the particular area on which they are encountered. Excavation and embankment quantities will be balanced as nearly as design and construction considerations allow. Any waste and/or borrow needs will be specifically identified.

- Turnouts. Intervisible turnouts will be constructed on resource roads leading to individual well sites.

- Drainage Design. Drainage and erosion control as described in Appendix B will be provided. Drainage ditches will be bladed and shaped in accordance with the lines, grades, dimensions, and typical cross section shown on the plans submitted with the individual APD.

- Culverts. Generally, culverts will be required for drilling and will be installed at the time of construction. These will be discussed in the individual APD and will follow installation specifications provided in BLM Manual 9113.

- Gates and Cattleguards. If any other gates or cattleguards not currently in place are needed, they will be listed in each individual APD.

- Existing Facilities. No existing facilities (e.g., gates, cattleguards, culverts, etc.) will be modified except as may be discussed in the individual APD.

2.0 LOCATION OF FACILITIES/HANDLING OF MATERIALS

2.1 Location of Existing Wells

Numerous wells, including productive and dry holes, exist in the GWA II. Locations of these existing wells are shown on Attachment 2 and will be shown on an attached exhibit to the individual APD.

2.1.1 Location of Existing and/or Proposed Facilities

The location of the well site and proposed new access road (if planned for construction) are shown on Attachment 2 and will be shown on the individual APD.

All gas lines will be buried by standard ditching and back filling. Pipelines installed will follow existing roads wherever possible. Pig launchers will be located close to existing roads or planned new road construction to reduce additional site disturbance. If the pipeline route is to deviate from the road ROW, pipeline construction and installation will begin by clearing a ROW not to exceed 50 feet in width. Either brushbeaters or graders will be used to clear the ROW, depending upon severity of terrain and safety practices on any steep slopes. ROW clearing and reclamation will follow guidelines provided in the Reclamation Recommendations in Appendix B of the project EIS.

2.1.2 Location and Type of Water Supply

- Location and Type. There are several water wells within the GWA II that could be used for drilling purposes. The location of the wells and the permit holder for the wells are shown in Table C-1.

Table C-1. Location of Wells and Permit Holders.

Location of Water Wells Used for Drilling	Total Depth (feet)	Average Rate (gals/min)	Permittee
SE/NE 16-19N - 93W	460	100	UPRC/AMOCO
SE/NE 21-19N - 93W	460	100	UPRC/AMOCO
NE 33-20N - 93W	520	100	UPRC/AMOCO
NW/NE 26-20N - 93W	760	90	UPRC/AMOCO
NE 28-19N - 93W	475	100	UPRC/AMOCO
NE 30-19N - 93W	520	60	UPRC/AMOCO
SW/NE 32-20N - 92W	860	50	UPRC/AMOCO
NE 30-20N - 93W	620	90	UPRC/AMOCO
NE 20-19N - 93W	400	90	UPRC/AMOCO
SE/NE 6-19N - 92W	740	90	UPRC/AMOCO
SW/NW 12-19N - 93W	740	90	UPRC/AMOCO
NE 28-20N - 93W	600	90	UPRC/AMOCO

As necessary, UPRC and other operators within the GWA II will drill water source well(s) on several of the drill sites. Water wells will be drilled in accordance with the Wyoming State Engineer's "Water Well Minimum Construction Standards." Upon completion of the well, a completed copy of the State of Wyoming Form U.W.6 will be sent to the authorized officer (AO).

- Method of Transportation. Water for drilling will be hauled to the drill site locations by tank trucks using existing or proposed roads in the GWA II if a water well is not drilled. Water wells drilled are used for 45 days then remain dormant or are left for surface owner use.

2.2 Source of Construction Materials

For drill site locations and access road construction purposes, only native soil materials will be used with cut-and-fill sections. In the event the well is completed as a producer, graveling of all or part of the access road and drill site location will be done using local suppliers in the marketing area.

2.3 Methods of Handling Waste Disposal

- Cuttings and Drilling Fluids. Cuttings and drilling fluids, including salts and chemicals that are deposited during drilling operations, will be put in an earthen or lined reserve pit. Water will be allowed to evaporate, the solids will be buried, and the pit area will be leveled.

- Produced Fluids. Test tanks and lined pits will be used for storage of produced fluids during drill stem testing or completion. (Motor change oil will be placed in containers and disposed of in an authorized disposal site.)

- Sewage. Sewage will be contained in portable chemical latrines and hauled to a State-approved disposal site.

- Garbage. All garbage will be hauled to a landfill approved by the Wyoming Department of Environmental Quality.

- Salts. Water produced with gas in the GWA II is generally condensed water vapor of low total dissolved solid (TDS) content. Estimated volumes based on Petroleum Information, Inc. (PI) reported production data are less than 1 BWPD per well. Disposal of water would be by means of lined evaporation pit(s) approved for use within the GWA II or by containment in a 'Tin Horn' (metal containment tank) located on the well pad.

- Chemicals. Other than normal drilling compounds, no toxic chemicals or other substances will be utilized in conjunction with the natural gas production operations.

2.4 Ancillary Facilities

Each individual natural gas production site would be approximately 2.1 acres (300 feet by 300 feet). A central production facility would not be necessary since each producing well would be accommodated by its own production facility. Electricity would not be required to operate the well or facilities. The production system would be powered by a series of solar cells and batteries. All wells would eventually be automated (i.e., measurements of gas and condensate would be obtained through an electric gas measurement system). Condensate would be measured through electric tank level indicators. Cathodic protection is also utilized on many wells in the GWA II.

2.5 Well Site Layout

- Cuts and Fills. Drill pad cross sections, cuts, fills, soil stockpiles, and rig orientation will be included with each individual APD.

- Location of Pits and Stockpiles. The location of pits and stockpiles will be shown on the individual APD. Normally, stockpiles and pits will be contained on the drill site.

- Pits. All reserve pits will be diked to keep out runoff water and will only be lined with a 12-to-16mm reinforced ultra violet- and hydrocarbon-resistant liner as fluid contents dictate. All reserve pits will be fenced stock-tight at the time of construction.

3.0 PLANS FOR RECLAMATION OF SURFACE

Reclamation of disturbed areas will follow reclamation guidelines provided in Appendix B of the EIS and site-specific plans for surface restoration contained in the individual APD.

- All water in the drill site reserve pit will be left to dry. The reserve pit will be backfilled after dried and leveled back to the ground contour that existed prior to construction.

- If the well is completed as a producer, the unused area will be leveled to the original ground contour, the stockpiled topsoil re-spread and leveled, and the area revegetated and rehabilitated. Specific reclamation procedures to be followed are provided in the Reclamation Recommendations provided in Appendix B of the project EIS. If the well is a dry hole, the entire area will be handled in the above manner.

- Restoration of the location will begin within two to four weeks after the well is completed or plugged. Restoration and seeding will take one to two weeks to complete. If the operation is completed during winter months, revegetation will be deferred until spring.

The well pad for a producing well will be reduced in size by approximately half, from 3.67 acres to 2.1 acres, after installation of production equipment. The unused portion will be restored to its original contour and reseeded within one year. Seeding will take place in the fall (Sept. 15 to freeze up), where feasible, and in the spring (prior to April 15) where fall reseeding is not feasible. Reseeding will also be done six feet on both sides of all roads and pipeline ROWs, substantially reducing the overall disturbance area. The entire well pad and access road for all unproductive locations will be reclaimed within one year.

4.1 Surface Ownership

The surface ownership within the GWA II is shown in Exhibit 1-4 of the project EIS. To summarize, of the 334,191 acres in the GWA II, 168,039 acres are privately owned (50 percent), 146,912 are under federal ownership (44 percent), and 19,240 acres are owned by the State of Wyoming (6 percent).

4.2 Other Information

A qualified archeologist will conduct Class III archeology surveys on the public well sites and access roads currently not having archeological clearance for construction.

All equipment and vehicles will be confined to access roads, well sites, and any additional areas specified in the individual APDs.

The following are operator's field representatives who are responsible for assuring compliance with the approved Surface Use and Operations Plans:

(TO BE COMPLETED BY THE APPROPRIATE GWA II OPERATOR.)

5.0 Lessee's or Operator's Representative and Certification

I hereby certify that I, or persons under my direct supervision, have inspected the project area and access routes; that I am familiar with conditions which presently exist; that the statements made in this plan are, to the best of my knowledge, true and correct; and that the work associated with operations proposed herein will be performed by (*insert operator name*) and its contractors and subcontractors in conformity with this plan and the terms and conditions under which it is approved.

______________________________	______________________________
(Authorized signature)	(Authorized signature)

APPENDIX C.2

MASTER DRILLING PLAN

GREATER WAMSUTTER AREA II NATURAL GAS PRODUCTION PROJECT

1. Geologic name of the surface formation is the Tertiary/Eocene Wasatch Formation.

2. The estimated tops of geologic markers vary from well to well. The tops will be listed on the individual APD for each well.

3. The estimated depths anticipated to encounter water, oil and gas bearing formations vary from well to well. This information will be listed in the individual APD for each well.

4. A casing program will be submitted for the deepest APD. Shallower depth wells will have safety factors in excess of the submitted design. Casing designs are specific to the type of wellbore being drilled (vertical, directional or horizontal).

5. Operator's minimum specifications for pressure control equipment planned for use follow.

   a. Diagram "A" is a schematic diagram of the blowout preventer stack. The preventer will be hydraulically tested to working pressure and the annular to 70 percent of working pressure initially and whenever repairs or modifications are made to any pressure containing part or actuator or whenever a leak is suspected. Pipe rams, blind rams, and annular will be function tested every trip. All tests and operational checks will be recorded on the daily drilling report. The BOPs will be tested at least every 30 days.

   b. A 5,000 psi WP choke manifold (see Diagram A) will also be tested to full working pressure upon installation.

   c. A 5,000 psi WP HCR valve will be placed on the choke lines between the BOPs and the choke manifold.

   d. The BOP closing unit will be equipped with accumulator bottles of sufficient volumetric capacity to close all ram preventers and annular preventer, and retain 200 psi above the acceptable precharge pressure. Ram type preventers will be equipped with some type of manual control.

   e. A hydraulic control will be located on the rig floor, and a backup control will be located in the accumulator house. A kelly cock, floor safety valve, and inside BOP will be installed on the rig floor.

6. Auxiliary equipment to be utilized include:

- Kelly cock
- Lower Kelly valve
- Mud Gas Separator
- Pit Volume Totalizer
- Drill pipe safety valve or an inside blowout preventer.
- Directional Equipment

7. Proposed mud system is shown in Table C-2.

The mud system will be a water-based gel/chemical system. A sufficient amount of barite shall be on location to weight up the mud system, should higher than expected subsurface pressures require it. Adequate stocks of mud reserve material (equal to the active mud system capacity) will be on hand to meet any lost circulation or well control problems.

Table C-2. Proposed Mud System.

Depth	Type	MW (ppg)	Viscosity (sec/qt.)	Fluid Loss (cc)
0'-2,200'	gel/lime	8.8 - 8.9	30 - 50	n/c
2,200'-6,500'	water/flocculent	8.4 - 9.0	26 - 29	n/c
6,500'-10,300'	low solids, non dispersed	8.8 - 10.2	32 - 45	10 - 15

8. Logging and Coring Programs are listed below.

a. The logging program will consist of:

Dual Induction - SFL	surf. csg. shoe to TD
Acoustic	surf. csg. shoe to TD
Density/Neutron	TD to top of Almond

b. Coring is possible for the Almond Sand.

9. The cementing program consists of the following:

a. Surface casing will be set to protect the shallower freshwater aquifers and then cemented to surface.

b. The production casing will be cemented with sufficient cement to properly cover all hydrocarbon intervals.

10. Anticipated abnormal pressures and temperatures and other potential hazards are addressed below.

a. The Almond section has shown to be abnormally pressured on other wells in this area. Mud weights as high as 10.3 ppg may be required to control pressures in this formation.

b. Other wells in the area indicate H_2S is not expected.

APPENDIX D

HAZARDOUS MATERIALS MANAGEMENT PLAN

APPENDIX D

HAZARDOUS MATERIALS MANAGEMENT PLAN

D.0 INTRODUCTION

Union Pacific Resources Company (UPRC) and other oil and gas operators propose to explore and develop natural gas reserves in the Greater Wamsutter Area II (GWA II) of Carbon and Sweetwater Counties, Wyoming. The Bureau of Land Management (BLM) has prepared an Environmental Impact Statement (EIS) for the proposed project, and this Hazardous Material Management Summary (HMMS), which is included as an appendix to the EIS, provides further specific information regarding the types and quantities of hazardous and extremely hazardous materials that are expected to be produced or used for the proposed project. Detailed descriptions of the proposed action and alternatives, the potential environmental consequences, and proposed mitigation and monitoring measures are provided in the EIS.

This HMMS is provided pursuant to BLM Instruction Memoranda Numbers WO-93-344 and WY-94-059, which require that all National Environmental Policy Act (NEPA) documents list and describe any hazardous and/or extremely hazardous materials that would be produced, used, stored, transported, or disposed of as a result of a proposed project. Hazardous materials, as defined herein, are those substances listed in the Environmental Protection Agency's (EPA's) *Consolidated List of Chemicals Subject to Reporting Under Title III of the Superfund Amendments and Reauthorization Act (SARA) of 1986*, and extremely hazardous materials are those identified in the EPA's *List of Extremely Hazardous Substances* (40 Code of Federal Regulations [CFR] 355). Materials identified on either of these lists that are expected to be used or produced by the proposed project are discussed herein.

A list of hazardous and extremely hazardous materials that are expected to be produced, used, stored, transported, or disposed of as a result of the GWA II Project was obtained from UPRC, along with Material Safety Data Sheets (MSDS) for all chemicals, compounds, and/or substances which may be used during the construction, drilling, completion, and production operations of the proposed project. UPRC has reviewed the aforementioned EPA lists, as amended, and all materials included on either of these two lists that would be used or produced by the proposed project were identified.

Some potentially hazardous materials that may be used in small, unquantifiable amounts have been excluded from this HMMS. These materials may include: wastes, as defined by the Solid Waste Disposal Act; wood products' manufactured items and articles which do not release or otherwise result in exposure to a hazardous material under normal conditions of use (i.e., steel structures, automobiles, tires, etc.); food, drugs, tobacco products, and other miscellaneous substances (i.e., WD-40, gasket sealants, glues, etc.). No unauthorized use or disposal of these materials by project personnel would occur during project implementation, and all project personnel would be directed to properly dispose of these materials in an appropriate manner. Solid wastes generated at well locations would be collected in approved waste facilities (e.g., dumpsters), and each well location would be provided with one or more such facilities during drilling and completion operations. Solid wastes would be regularly removed from well locations and transported off the GWA II to approved disposal facilities.

D.1 HAZARDOUS MATERIALS

A listing of all relevant known hazardous and extremely hazardous materials that are expected to be used, produced, stored, transported, or disposed of during project implementation is provided herein. Where possible, the quantities of these materials have been estimated on a per-well basis and their use, storage, transport, and disposal methods defined. Use of additional hazardous and extremely hazardous materials will occasionally be required due to unforeseen circumstances. A listing of the compounds is provided herein.

D.2 PRODUCTION PRODUCTS

The purpose of the proposed project is to extract natural gas and oil (condensates) from the Mesa Verde Group and other formations underlying the GWA II. Water would also be produced as a by-product of gas and oil extraction operations. Table D-1 lists and quantifies, where possible, the hazardous and extremely hazardous materials that may be found in these production products.

D.2.1 Natural Gas

Natural gas, primarily containing methane, ethane, and carbon dioxide, would be produced from 200 to 330 wells at rates averaging 0.4 million cubic feet per day (mmcfd) per well. No extremely hazardous materials are anticipated to be produced with the gas stream; however, the hazardous material hexane (CAS Number 110-54-3) would be present in the gas stream at volumes ranging from approximately 4 to 24 thousand cubic feet per day (mcfd) per well (Table D-1). In addition, the gas would also likely contain small amounts of potentially hazardous polycyclic organic matter and polynuclear aromatic hydrocarbons. No other hazardous materials are known to occur within the natural gas stream.

The majority of gas produced from GWA II wells would be transported from each location through newly constructed pipelines linking well locations to existing or newly constructed gas processing facilities. The natural gas would eventually be delivered to consumers for combustion. Small quantities of natural gas may be vented or flared at certain well locations during well testing operations. During testing, produced gas would be vented or flared into a flare pit pursuant to BLM/Wyoming Oil and Gas Conservation Commission (WOGCC) rules and regulations (Notice to Lessees [NTL]-4A). BLM and WOGCC approval would be obtained prior to flaring or venting operations. No natural gas storage is anticipated by the proposed project.

Table D-1. Hazardous and Extremely Hazardous Materials Potentially Produced by the Greater Wamsutter Area II Natural Gas Project, Carbon and Sweetwater Counties, Wyoming, 1994.

Production Product	Hazardous Constituents[1]	Extremely Hazardous Constituents[2]	Approximate Quantity Produced per Well[3]
Natural Gas	-- Hexane PAHs[4] POM[5]	None	0.4 mmcfd 4-24 mcfd
Condensates	-- PAHs POM	None	252 gpd
Produced Water	-- Lead Cadmium Chromium Radium 226 Uranium	None	168 gpd

[1] The hazardous constituents listed are, to the best of our present knowledge, those that are or may be present in the production products and are listed under the EPA's *Consolidated List of Chemicals Subject to Reporting Under Title III of the Superfund Amendments and Reauthorization Act (SARA) of 1986*, as amended.
[2] Extremely hazardous materials are those defined in 40 CFR 355.
[3] mmcfd = million cubic feet per day.
mcfd = thousand cubic feet per day.
gpd = gallons per day.
[4] PAHs = polynuclear aromatic hydrocarbons.
[5] POM = polycyclic organic matter.

Industry standard pipeline equipment, materials, techniques, and procedures in conformance with all applicable regulatory requirements would be employed during construction, testing, operation, and maintenance of the project to ensure pipeline safety and efficiency. All necessary authorizing actions for natural gas pipelines would be addressed prior to installation. These actions include:

- Carbon and Sweetwater County special use permits;
- BLM rights-of-way (ROWs) applications, conformance with U.S. Department of Transportation (DOT) pipeline regulations (49 CFR 191-192); and
- Wyoming Public Service Commission Certificates to act as common carrier for natural gas.

D.2.2 Condensates

Condensates would be produced with the gas stream at most of the proposed wells. Condensates primarily consist of long chain hydrocarbon liquids (e.g., octanes), but may also contain variable quantities of the following hazardous materials: polycyclic organic matter and polynuclear aromatic hydrocarbons. No other hazardous or extremely hazardous materials are known to be present in the condensates. The volume of condensate produced from GWA II wells is anticipated to be approximately 252 gallons per day (gpd) from most wells (Table D-1).

Condensates would be stored in tanks at well locations and centralized facilities, and all tanks would be fenced and bermed to contain the entire storage capacity of the largest tank plus one foot of freeboard as mandated by the BLM. Condensates would be periodically removed from storage tanks and transported by truck, in adherence to DOT rules and regulations, off the GWA II. All necessary authorizing actions for the production, storage, and transport of condensates, including the Oil Pollution Act of 1990 (storage of >1,000,000 gal) as necessary, would be addressed prior to the initiation of condensate production activities.

D.2.3 Produced Water

Produced water from GWA II wells is anticipated to range in volume from 0 to 630 gpd, and would average approximately 168 gpd for most wells (Table D-1). Produced water quality from wells on the GWA II is variable and would be monitored periodically. Based on WOGCC-required water quality analyses of produced water samples from several GWA II wells, no hazardous or extremely hazardous materials are known to occur. However,water from the Mesa Verde Group Formation at locations in the Washakie and Great Divide Basins is known to contain the following hazardous materials: lead (CAS 7439-92-1), cadmium (CAS 7440-43-9), chromium (CAS 7440-47-3), radium 226, and uranium. Water quality analyses of gross radiation for existing wells indicated only background radiation levels. No other hazardous or extremely hazardous materials are known to be present in the produced water.

Produced water would be stored in tanks at well locations and centralized facilities and would periodically be removed and transported by truck to the existing Wyoming Department of Environmental Quality (WDEQ) permitted disposal well facility. Where applicable, National Pollutant Discharge Elimination System (NPDES) permits would be obtained from the WDEQ, and produced water that meets applicable standards would be discharged to the surface at appropriate locations. All necessary authorizing actions would be met prior to the disposal of produced water including:

- BLM approval of disposal methodologies;
- RCRA compliance as necessary;
- WDEQ Water Quality Division (WDEQ-WQD) approval of wastewater disposal;

- WOGCC evaporation pond permits; and
- Wyoming State Engineer's Office (WSEO) dewatering permits (Form U.W. 5).

D.3 CONSTRUCTION, DRILLING, PRODUCTION, AND RECLAMATION

Known hazardous and extremely hazardous materials planned for use during typical construction, drilling, production, and reclamation operations for the proposed project are listed in Table D-2 and are described in detail below. Hazardous and extremely hazardous materials planned for use during project implementation fall into the following categories:

- Fuels;
- Lubricants;
- Coolant/antifreeze and heat transfer agents;
- Drilling fluids;
- Fracturing fluids;
- Cement and additives; and
- Miscellaneous materials.

D.3.1 Fuels

Gasoline (CAS 8006-61-9), diesel fuel (CAS 68476-30-2), and natural gas are the fuels proposed for use by the project, and all contain materials deemed hazardous. Gasoline would be used to power vehicles providing transportation to and from the GWA II; diesel fuel would be used to power transport vehicles, drilling rigs, and construction equipment, and as a component of fracturing fluids (see Section D.2.5); and natural gas would be used to power pipeline compressor stations.

D.3.1.1 Gasoline

Gasoline would be used to power vehicles traveling to and from the GWA II. The hazardous and extremely hazardous materials likely to be found in gasoline are listed in Table D-2. The hazardous materials present in gasoline include: benzene (CAS 71-43-2), toluene (CAS 108-88-3), ethylbenzene (CAS 100-41-4), p-xylene (CAS 106-42-3), m-xylene (CAS 108-38-3), o-xylene (CAS 95-47-6), methyl tert-butyl ether (CAS 1634-04-4), polynuclear aromatic hydrocarbons, and polycyclic organic matter. Leaded gasoline contains tetraethyllead (CAS 78-00-2), which is listed as an extremely hazardous material (Table D-2).

Gasoline would be purchased off the GWA II from regional vendors, and would primarily be stored and transported in vehicle gas tanks. Some additional gasoline storage may be provided in appropriately designed and labeled 1 to 5 gallon containers for supplemental use as vehicle fuel. Gasoline would be used exclusively as a fuel for transport vehicles, being burned in internal combustion engines. No large scale storage of gasoline is anticipated.

Table D-2. Hazardous and Extremely Hazardous Materials Potentially Utilized During Construction, Drilling, Production, and Reclamation Operations by the GWA II Natural Gas Project, Carbon and Sweetwater Counties, Wyoming, 1994.

Source	Hazardous Constituents[1]	Extremely Hazardous Constituents[2]	Approximate Quantity Used Per Well[3]
Fuel			
Gasoline	Benzene Toluene Ethylbenzene p-xylene m-xylene Methyl tert-butyl ether PAHs[4] POM[5] Tetraethyllead	Tetraethyllead	24,940 gal
Diesel Fuel	Benzene Toluene Ethylbenzene p-xylene m-xylene o-xylene Methyl tert-butyl ether Naphthalene PAHs POM	None	27,400 gal
Natural Gas	Hexane PAHs POM	None	
Lubricants	PAHs POM Lead Cadmium Manganese Barium Zinc Lithium	None	> 8 gal
Coolant/Antifreeze and Heat Transfer Agents	Ehylene glycol Triethylene glycol	None	> 180 gal 330 gal
Drilling Fluid Additives			
Caustic Soda	Sodium hydroxide	None	650 lbs
Lime	Fine mineral fibers	None	3,500 lbs

Source	Hazardous Constituents[1]	Extremely Hazardous Constituents[2]	Approximate Quantity Used Per Well[3]
Mica	Fine mineral fibers	None	600 lbs
Uni-Drill	Acrylamide	None	50 gal
Uni-Gel	Fine mineral fibers	None	43,500 lbs
UNIBAR	Barium compounds	None	8,200 lbs
Fracturing Fluid Additives			
LGC-VI w/diesel fuel	Benzene Toluene Ethylbenzene p-xylene m-xylene o-xylene Methyl tert-butyl ether Naphthalene PAHs POM	None	953 gal
OPTI-FLO III	Glycol ether	None	144 lbs
SSO-21	Methanol Glycol Ether	None	15 gal
CL-29	Formic acid Ammonium chloride Zirconium nitrate Zirconium sulfate	None	59 gal
BA-20	Acetic acid	None	38 gal
Sand	Fine mineral fibers	None	2,994 lbs
Cement and Additives	Fine mineral fibers PAHs POM	None	>10,000 lbs
Miscellaneous Materials	Methanol Corrosion inhibitors	None	3,000 gal

[1] - The hazardous constituents listed are, to the best of our present knowledge, those that are or may be present in the production products and are listed under the EPA's *Consolidated List of Chemicals Subject to Reporting Under Title III of the Superfund Amendments and Reauthorization Act (SARA) of 1986*, as amended.
[2] - Extremely hazardous materials are those defined in 40 CFR 355.
[3] - lb = pounds
gal = gallons.
[4] - PAHs = polynuclear aromatic hydrocarbons.
[5] - POM = polycyclic organic matter.

D.3.1.2 Diesel Fuel

Diesel fuel for vehicle use would be used, transported, and stored as described in Section D.3.1.1 for gasoline. Using the same assumptions as for gasoline, approximately 24,940 gallons of fuel would be required per well for proposed project transportation. Additional diesel fuel would be utilized to power drilling rigs (820 gal/well), workover rigs (440 gal/well), pumping equipment (600-700 gal/well), and road maintenance and reclamation equipment (550 gal/well). Diesel fuel would also be used as a fracturing fluid constituent (see Section D.3.5).

Diesel fuel consists mainly of hydrocarbons containing from 15 to 25 carbons, and potentially contains hazardous materials, including: benzene, toluene, ethylbenzene, p-xylene, m-xylene, o-xylene, methyl tert-butyl ether, naphthalene, polynuclear aromatic hydrocarbons, and polycyclic organic matter. No extremely hazardous materials are known to be present in diesel fuel.

Each well location during drilling operations would have an aboveground storage tank containing diesel. These tanks would be filled as needed by a qualified, licensed fuel supplier, and use, transport, and storage of diesel fuel would be conducted in accordance with all relevant state and/or federal rules, regulations, and guidelines.

D.3.1.3 Natural Gas

An unknown volume of natural gas would be burned to provide power for the natural gas compressor stations required for efficient pipeline function. The natural gas used to power compressor stations would be produced by the proposed project, and hazardous materials contained in this natural gas are identified in Table D-2. Further detail on the transportation of natural gas as a result of the proposed project, and relevant authorizing actions for natural gas transportation, is provided in Section D.2.1.

D.3.2 Lubricants

Various lubricants, including: motor oils, hydraulic oils, transmission oils, compressor lube oils (8 gal/well), and greases, would be utilized for project-required vehicles, rigs, compressors, and other machinery. Some of these lubricants would likely contain polynuclear aromatic hydrocarbons and polycyclic organic matter, and some may additionally contain compounds of lead, cadmium, nickel, copper, manganese, barium, zinc, and/or lithium. No extremely hazardous materials are known to be present in the lubricants required for the proposed project.

The quantity of each lubricant used, stored, transported, and disposed of is unknown; however, all lubricants would be used, stored, transported, and disposed of following manufacturer's guidelines. No unauthorized disposal of lubricants (e.g., disposal of used motor oil) would occur in GWA II.

D.3.3 Coolant/Antifreeze and Heat Transfer Agents

Ethylene glycol (CAS 107-21-1) and triethylene glycol (CAS 112-27-6) would be utilized as coolant/antifreeze and heat transfer agents in association with this project (Table D-2). Ethylene glycol would be used as an engine coolant/antifreeze in automobiles, construction equipment, gas dehydrators, and drilling and workover rigs. An unspecified volume of this hazardous material would be stored and transported in engine radiators. In addition, both ethylene glycol and triethylene glycol would be used as heat transfer fluids during well completion and maintenance operations. The estimated quantity of ethylene glycol required per well for completion and maintenance operations is 180 gallons for the life of the project. The quantity of triethylene glycol required would range from approximately 290 to 370 gallons/well. While the total volume of ethylene glycol to be used, stored, transported, and disposed of for the proposed project is unknown, any disposal of ethylene glycol and/or triethylene glycol would be conducted in accordance with all relevant federal and state rules and regulations.

D.3.4 Drilling Fluids

Fresh water would be used for drilling the first 5,000 to 7,000 feet of each well, and water-based muds (drilling fluids) would be used for drilling deeper portions of each well. Drilling fluids consist of clays and other additives that are used in standard industry procedures. Drilling fluid additives to be utilized for the proposed project include: caustic soda (650 lbs/well), cedar fibers (200 lbs/well), lime (3,500 lbs/well), mica (600 lbs/well), Uni-Drill (50 gal/well), Uni-Gel (43,500 lbs/well), and paper (400 lbs/well) (Table D-2). All drilling operations would be conducted in compliance with applicable BLM, WOGCC, and WDEQ rules and regulations.

All known hazardous materials present in the proposed drilling fluids and additives are listed in Table D-2 These materials are: sodium hydroxide (CAS 1310-73-2), present in caustic soda; acrylamide (CAS 79-06-1), present in Uni-Drill (partially hydrolyzed polyacrylamide); barium compounds, present in UNIBAR (barium sulfate); and fine mineral fibers, present in lime, mica, and Uni-Gel (sodium montmorillonite or barite). No hazardous materials are known to occur in sawdust or paper, and no extremely hazardous materials are known to be present in any of the drilling fluids and additives.

Drilling fluid additives would be transported to well locations during drilling operations in appropriate sacks and containers in compliance with DOT regulations. Drilling fluids, cuttings, and water would be stored in reserve pits, and pits would be fenced to protect wildlife from exposure. Netting (1 inch mesh), to protect waterfowl and other birds, and pit liners, to protect shallow groundwater aquifers, would be used on all reserve pits as deemed appropriate by the BLM.

When the reserve pit is no longer required, its contents would be evaporated or solidified in place, and the pit backfilled, as approved by the BLM. All reserve pit solidification procedures using flyash or other BLM-approved materials would be approved by the WOGCC and/or WDEQ prior to implementation. If necessary under special, unanticipated circumstances, reserve pit contents would be removed and disposed of at an appropriate facility in a manner commensurate with all relevant state and federal regulations.

D.3.5 Fracturing Fluids

Hydraulic fracturing is expected to be performed at all GWA II wells to augment gas flow rates. Approximately 78,700 gallons of fracturing fluids, consisting primarily of fresh water, would be required per well for the proposed project. Fracturing fluid additives and their approximate volumes include: LGV-VI with diesel fuel (953 gal/well), GES-STA (150 lbs/well), OPTI-FLO III (144 lbs/well), CLAYFIX II (157 lbs/well), SSO-21 (15 gal/well), CL-29 (59 gal/well), BA-20 (38 gal/well), SP BREAKER (27 lbs/well), GBW-30 (9 lbs/well), BE-5 microbiocide (36 lbs/well), and sand (299,400 lbs/well) (Table D-2).

The hazardous materials present in fracturing fluid components are listed in Table D-2 and include: benzene, toluene, ethylbenzene, p-xylene, m-xylene, o-xylene, methyl tert-butyl ether, naphthalene, polynuclear aromatic hydrocarbons, and polycyclic organic matter contained in LGC-VI with diesel fuel (hydrocarbon gel concentrate); glycol ether present in OPTI-FLO III and SSO-21; methanol (CAS 67-56-1) present in SSO-21; formic acid (CAS 64-18-6), ammonium chloride (CAS 12125-02-9), zirconium nitrate (CAS 13746-89-9), and zirconium sulfate (CAS 14644-61-2) present in CL-29; acetic acid (CAS 64-19-7) present in BA-20; and fine mineral fibers present in sand. No hazardous materials are known to be present in GEL-STA (sodium salt), CLAYFIX II (alkylated quaternary chloride), SP BREAKER (sodium persulfate), GBW-30 (cellulase enzyme carbohydrate), and BE-5 (5-chloro-2-methyl-4-isothiazolin-3-one, 2-methyl-4-isothiazolin-3-one, a microbiocide). No extremely hazardous materials are known to be present in any of the fracturing fluid additives.

Fracturing fluids and additives would be transported to well locations in bulk (e.g., LGC-VI with diesel fuel, sand) or in appropriately designed and labeled containers (e.g., OPTI-FLO III in 50 lb fiber drums; SSO-21, CL-29, and BA-20 in 55 gal drums). All transportation of fracturing fluids and additives would be in adherence with DOT rules and regulations.

During fracturing, fluids are pumped under pressure down the well bore and out through perforations in the casing into the formation. The pressurized fluid enters the formation and induces hydraulic fractures. When the pressure is released at the surface, a portion of the fracturing fluids would be forced to the well bore and up into a tank. The fracturing fluids would then be transferred to lined reserve pits and evaporated, or hauled away from the location and reused or disposed of at an authorized facility. Decisions regarding the appropriate disposal of fracturing fluids would be made by the BLM on a case-by-case basis.

D.3.6 Cement and Additives

Well completion and abandonment operations would entail cementing and plugging various segments of the well bore to protect freshwater aquifers and other down-hole resources. Materials potentially used for cementing operations include: cement, calcium hydroxide, calcium chloride, pozzlans, sodium bicarbonate, potassium chloride, and insulating oil. An unknown quantity of cement and additives, which may contain the hazardous material classes of fine mineral fibers, polycyclic organic matter, and polynuclear aromatic hydrocarbons, would be transported in bulk to each well site by a qualified cement supply company. Small quantities may be transported and stored on-site in 50 pound sacks. Wells would be cased and cemented as directed and approved by the BLM (for federal minerals) and WOGCC (for state and patented minerals). No extremely hazardous materials are known to be present in the cement and additives proposed for use by this project.

D.3.7 Miscellaneous Materials

Miscellaneous materials, potentially containing hazardous and/or extremely hazardous materials, that may be used for the proposed project include: methanol and corrosion inhibitors. The material would be transported to the site by qualified service and supply companies and would be used and disposed of following manufacturer's guidelines.

An unknown quantity of methanol would be used to de-ice well bores and as a hydrate preventer during completion and natural gas transport operations. Methanol is a listed hazardous chemical and would be stored, transported, used, and disposed of in adherence with all applicable federal and state rules, regulations, and guidelines.

D.4 COMBUSTION EMISSIONS

Combustion emissions from gasoline and diesel engines, as well as flaring natural gas, will occur as a result of this project. The complete oxidation of hydrocarbon fuels yields only carbon dioxide and water as combustion products; however, complete combustion is seldom achieved. Unburned hydrocarbons, particulate matter (e.g., carbon, metallic ash), carbon monoxide, nitrogen oxides, and possibly sulfur oxides would be expected as direct exhaust contaminants. Secondary contaminants would likely include the formation of ozone from the photolysis of nitrogen oxides. A listing of the hazardous and extremely hazardous materials potentially present in combustion emissions is provided in Table D-3.

Table D-3. Hazardous and Extremely Hazardous Materials Potentially Present in Combustion Emissions of the GWA II Natural Gas Project, Carbon and Sweetwater Counties, Wyoming, 1994.

Emission	Hazardous Constituents[1]	Extremely Hazardous Constituents[2]
Hydrocarbons	PAHs[3]	None
Particulate Matter	Lead Cadmium Nickel Copper Manganese Barium Zinc Lithium	None
Gases	Nitrogen dioxide Sulfur dioxide Sulfur trioxide Ozone	Nitrogen dioxide Sulfur dioxide Sulfur trioxide Ozone

[1] - The hazardous constituents listed are, to the best of our present knowledge, those that are or may be present in the production products and are listed under the EPA's *Consolidated List of Chemicals Subject to Reporting Under Title III of the Superfund Amendments and Reauthorization Act (SARA) of 1986*, as amended.
[2] - extremely hazardous materials are those defined in 40 CFR 355.
[3] - PAHs = polynuclear aromatic hydrocarbons.

Unburned hydrocarbons may contain potentially hazardous polynuclear aromatic hydrocarbons, and particulate matter may contain metal-based particulates from lead anti-knock compounds in the fuel, metallic lubricating oil additives, and engine wear particulates (Table D-3). Hazardous materials in the particulate matter may therefore include compounds of lead, cadmium, nickel, copper, manganese, barium, zinc, and/or lithium.

Nitrogen dioxide (CAS 10102-44-0), sulfur dioxide (CAS 7446-09-5), sulfur trioxide (CAS 7446-11-9), and ozone (CAS 10028-15-6) are probable combustion emissions, all classified as extremely hazardous materials. These materials would be either directly released in minor quantities from internal combustion engines, or would be formed through photolysis (i.e., ozone). No releases of these or other materials would occur in excess of those allowed for Prevention of Significant Deterioration Class II areas, WDEQ-Air Quality Division Implementation Plan; nor would releases occur that jeopardize National Ambient Air Quality Standards for the GWA II. Particulate matter emissions and larger unburned hydrocarbons would eventually settle out on the ground surface, whereas gaseous emissions would react with other air constituents as components of the nitrogen, sulfur, and carbon cycles.

D.5 MANAGEMENT POLICY AND PROCEDURE

UPRC, other area operators, and their contractors would ensure that all production, use, storage, transport, and disposal of hazardous and extremely hazardous materials as a result of the proposed project would be in strict accordance with all applicable existing, or hereafter promulgated federal, state, and local government rules, regulations, and guidelines. All project-related activities involving the production, use, and/or disposal of hazardous or extremely hazardous materials would be conducted in such a manner as to minimize potential environmental impacts.

UPRC and the other area operators would comply with emergency reporting requirements for releases of hazardous materials. Any release of hazardous or extremely hazardous substances in excess of the reportable quantity, as established in 40 CFR 117, would be reported as required by the *Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980,* as amended. The materials for which such notification must be given are the extremely hazardous substances listed under the *Emergency Planning and Community Right to Know* Section 302 and the hazardous substances designated under Section 102 of CERCLA, as amended. If a reportable quantity of a hazardous or extremely hazardous substance is released, prompt notice of the release would be given to the BLM's Authorized Officer and all other appropriate federal and state agencies. Additionally, notice of any spill or leakage (i.e., undesirable event), as defined in BLM NTL-3A, would be given by UPRC or other area operators to the Authorized Officer and other such federal and state officials as required by law.

UPRC and the other area operators have evaluated field operations in the GWA II and have or would prepare and implement multiple plans and/or policies to ensure environmental protection from hazardous and extremely hazardous materials. These plans/policies shall be available for review at the BLM Great Divide Resource Area in Rawlins. These plans/policies include, where applicable:

- spill prevention and control countermeasure plans for each GWA II field;
- oil/condensate spill response plans;
- inventories of hazardous chemical categories pursuant to Section 312 of the SARA, as amended; and
- emergency response plans.

Development operations in the GWA II would be in compliance with regulations promulgated under the Resource Conservation and Recovery Act (RCRA), Federal Water Pollution Control Act (Clean Water Act), Safe Drinking Water Act (SWDA), Toxic Substances Control Act (TSCA), Occupational Safety and Health Act (OSHA), and the Federal Clean Air Act (CAA). In addition, project operations would also comply with all attendant state rules and regulations relating to hazardous material reporting, transportation, management, and disposal.

Table D-4. Generic List of Hazardous Chemical Categories for the Oil and Gas Exploration and Production Industry.

Hazardous Chemical Category (With Examples of Representative Chemicals)	Physical and Health Hazards
Acetylene Gas (CAS#74-86-2)	Fire, Sudden release of pressure
Acids Hydrochloric Acid (<30%) (CAS#7647-01-0) Hydrofluoric acid (<12%) (CAS#7664-39-3) Sulfuric acid (CAS#7664-93-9)	Immediate (Acute)
Alkalinity and pH Control Materials Calcium hydroxide (CAS#1305-62-0) Potassium hydroxide (CAS#1310-58-3) Soda ash (CAS#497-19-8) Sodium bicarbonate (CAS#144-55-8) Sodium carbonate (CAS#497-19-8) Sodium hydroxide (CAS#1310-73-2)	Immediate (Acute)
Biocides Amines Glutaraldehyde (CAS#111-30-8) Isoporpanol (CAS#67-63-0) Thiozolin	Immediate (Acute), Fire
Breakers Ammonium persulfate (CAS#7727-54-0) Benzoic acid (CAS#65-85-0) Enzyme Sodium acetate (CAS#127-09-3) Sodium persulfate (CAS#7772-27-1)	Immediate (Acute), Fire
Buffers Sodium acetate (CAS#127-09-3) Sodium bicarbonate (CAS#144-55-8) Sodium carbonate (CAS#497-119-8) Sodium deacetate	Immediate (Acute)

Hazardous Chemical Category (With Examples of Representative Chemicals)	Physical and Health Hazards
Calcium Compounds Calcium bromide (CAS#71626-99-8) Calcium hypochlorite (CAS#7778-54-3) Calcium oxide (CAS#1305-78-8) Gypsum (CAS#10101-41-4) Lime (CAS#1305-78-8)	Immediate (Acute)
Cement (CAS#65997-15-1)	Immediate (Acute)
Cement Additives - Accelerators Calcium chloride (CAS#10035-04-8) Gypsum (CAS#10101-41-4) Potassium chloride Sodium chloride (CAS#7647-14-5) Sodium metasilicate	Immediate (Acute)
Cement Additives - Fluid Loss Cellulose polymer Latex	Immediate (Acute)
Cement Additives - Miscellaneous Cellulose flakes (CAS#9004-34-6) Coated aluminum Gilsonite (CAS#12002-43-6) Lime (CAS#1305-78-8) Long chain alcohols	Immediate (Acute)
Cement Additives - Retarders Cellulose polymer Lignosulfonates	Immediate (Acute)
Cement Additves - Weight Modification Barite (CAS#7727-43-7) Bentonite Diatomatious earth (CAS#68855-54-9) Fly ash Glass beads Hematite (CAS#1317-60-8) Ilmenite Pozzolans	Immediate (Acute)

Hazardous Chemical Category (With Examples of Representative Chemicals)	Physical and Health Hazards
Chloride Salts Calcium chloride Potassium chloride Sodium chloride (CAS#7647-14-5) Zinc chloride (CAS#7646-85-7)	Immediate (Acute)
Chlorine Gas (CAS#7782-50-5)	Immediate (Acute), Sudden release of pressure
Corrosion Inhibitors 4-4' Methylene dianiline (CAS#101-77-9) Acetylenic alcohols Amine Formulations Ammonium bisulfite (CAS#10192-30-0) Basic zinc carbonate (CAS#3486-35-9) Gelatin Ironite sponge (CAS#1309-37-1) Sodium chromate (CAS#7775-11-3) Sodium dichromate (CAS#10588-01-9) Sodium polyacrylate Zinc lignosulfonate Zinc oxide (CAS#1314-13-2)	Immediate (Acute), Delayed (chronic), Fire
Crosslinkers Boron Compounds Organo-metallic complexes	Immediate (Acute), Fire
Defoaming Agents Aluminum stearate Fatty acid salt formation Mixed alcohols Silicones	Immediate (Acute)

Hazardous Chemical Category (With Examples of Representative Chemicals)	Physical and Health Hazards
Deflocculants Acrylic polymer Calcium lignosulfonate Chrome-free lignosulfonate Chromium lignosulfonate Iron lignosulfonate Quebracho Sodium acid pyrophosphate (SAPP) Sodium hexametaphosphate (CAS#10124-56-8) Sodium phosphate (oilfos) Sodium tetraphosphate Stryene, maleaic anhydride co-polymer salt Sulfo-methylated tannin	Immediate (Acute)
Detergents/Foamers Amphoteric surfactant formulation Ethoxylated phenol Detergents	Immediate (Acute), Fire
Explosives Charged well jet perforating gun, Class C explosives Detonators, Class A explosives Explosive power device, Class B	Sudden release of pressure

Hazardous Chemical Category (With Examples of Representative Chemicals)	Physical and Health Hazards
Filtration Control Agents Acrylamide AMPS copolymer Aniline formaldehyde copolymer hydrochlorite Causticized leonardite Sulfomethylated phenol formaldehyde Leonardite Partially hydrolyzed polyacrylamide Polyalkanolamine ester Polyamine acrylate Polyanionic cellulose Potassium lignite Preserved starch Sodium carboxymethyl cellulose (CAS#9004-32-4) Starch (CAS#9005-25-8) Vinylsulfonate copolymer	Immediate (Acute)
Flocculants Anionic polyacrylamide	Immediate (Acute)
Fluoride Generating Compounds Ammonium bifluoride (CAS#1341-49-7) Ammonium fluoride (CAS#12125-0108)	Immediate (Acute)
Friction Reducers Acrylamide methacrylate copolymers Sulfonates	Immediate (Acute)
Fuels Diesel (CAS#68476-34-6) Fuel oil Gasoline (CAS#8006-61-9)	Immediate (Acute), Delayed (Chronic), Fire
Gelling Agents Cellulose and guar derivatives	Immediate (Acute)

Hazardous Chemical Category (With Examples of Representative Chemicals)	Physical and Health Hazards
Gel Stabilizers Sulfites Thiosulfates	Immediate (Acute)
Hydrogen Sulfide (CAS#7783-06-4)	Immediate (Acute), Fire
Inert Gases Carbon Dioxide (CAS#124-38-9) Nitrogen (CAS#7727-37-9)	Immediate (Acute), Sudden release of pressure
Lost Circulation Materials Cane fibers Cedar fibers Cellophane fibers Corn cob Cottonseed hulls Mica (CAS#12001-26-2) Nut shells Paper Rock wool Sawdust	Immediate (Acute)
Lubricants, Drilling Mud Additives Graphite (CAS#7782-42-5) Mineral oil formulations Organo-fatty acid salt Vegetable oil formulations Walnut Shells	Immediate (Acute)
Lubricants, Engine Motor oil Grease	Immediate (Acute)
Miscellaneous Drilling Additives Diatomaceous Earth (CAS#68855-54-9) Oxalic acid (CAS#144-62-7) Potassium acetate (CAS#127-08-2) Zinc bromide (CAS#7699-45-8)	Immediate (Acute), Delayed (Chronic)

Hazardous Chemical Category (With Examples of Representative Chemicals)	Physical and Health Hazards
Odorants Mercaptans, aliphatic	Immediate (Acute)
Oil Based Mud Additives Amid polymer formulations Amine treated lignite Asphalt Diesel (CAS#68476-34-6) Gilsonite (CAS#12002-43-6) Mineral oil Organophilic clay Organophilic hectorite Petroleum distillate (CAS#8030-30-6) Polymerized organic acides Sulfonate surfactant	Immediate (Acute), Delayed (Chronic), Fire
Organic Acids Acetic acid (CAS#64-19-7) Acetic anhydride (CAS#108-24-7) Benzoic acid (CAS#65-85-0) Citric acid (CAS#5949-29-1) Formic acid (CAS#64-18-6) Organic acid salts	Immediate (Acute), Fire
Preservatives Dithiocarbamates Paraformaldehyde (CAS#30525-89-4) Isothiazions	Immediate (Acute)
Produced Hydrocarbons Condensate Crude oil (CAS#8002-05-9) Natural Gas	Immediate (Acute), Delayed (Chronic), Fire, Sudden release of pressure
Proppants Bauxite (CAS#1318-16-7) Resin coated sand Zirconium proppant	Immediate (Acute)

Hazardous Chemical Category (With Examples of Representative Chemicals)	Physical and Health Hazards
Radioactive, Special Form Cesium 137 (encapsulated) logging tool	Delayed (Chronic)
Resin and Resin Solutions Melamine resins Phenolic resins Polyglycol resins	Immediate (Acute), Fire
Salt Solutions Aluminum chloride (CAS#7446-70-0) Ammonium chloride (CAS#12125-02-9) Calcium bromide (CAS#17626-99-8) Calcium chloride (CAS#10035-04-8) Calcium sulfate (CAS#778-18-9) Ferrous sulfate (CAS#7782-63-0) Potassium chloride(CAS#7447-40-7) Sodium chloride (CAS#7647-14-5) Sodium sulfate (CAS#7757-82-6) Zinc bromide (CAS#7699-45-8) Zinc chloride (CAS#7646-85-7) Zinc sulfate	Immediate (Acute)
Scale Inhibitors Ethylenediaminetetraacetic acid (EDTA) (CAS#60-00-4) Inorganic phosphates Isopropanol (CAS#67-63-0) Nitrilotriacetic acid (NTA) (CAS#139-13-9) Organic phosphates Polyacrylate Polyphosphates	Immediate (Acute), Fire

Hazardous Chemical Category (With Examples of Representative Chemicals)	Physical and Health Hazards
Shale Control Additives Hydrolyzed polyacrylamide polymer Organo-aluminum complex Polyacrylate polymer Sulfonated asphaltic residuum	Immediate (Acute)
Silica	Immediate (Acute), Delayed (Chronic)
Solvents 1,1,1-Trichloreoethane (CAS#71-55-6) Acetone (CAS#67-64-1) Aliphatic hydrocarbons Aromatic naphtha (CAS#8032-32-4) Carbon tetrachloride (CAS#56-23-5) Diacetone alcohol Ethylene glycol monobutyl ether (CAS#111-76-2) Kerosene (CAS#8008-20-6) Isopropanol (CAS#67-63-0) Methyl ethyl ketone (MEK) (CAS#78-93-3) Methyl isobutyl ketone (MIBK) (CAS#108-10-1) Methanol (CAS#67-56-1) t-Butyl alcolhol (CAS#75-65-0) Toluene (CAS#108-88-3) Turpentine (CAS#8006-64-2) Xylene (CAS#1330-20-7)	Immediate (Acute), Delayed (Chronic), Fire
Spotting Fluids Nonoil base spotting fluid Oil base spotting fluid (diesel oil base) Oil base spotting fluid (mineral oil base) Sulfonated vegetable ester	Immediate (Acute), Fire

Hazardous Chemical Category (With Examples of Representative Chemicals)	Physical and Health Hazards
Surfactants - Corrosive Alcohol ether sulfates Amines Quarternary polyamine Sulfonic acids	Immediate (Acute)
Surfactants - Flamable Amines Ammonium salts Fatty alcohols Isopropanol (CAS#67-56-1) Oxylalkylated phenols Petroleum naphtha (CAS#8030-30-6) Sulfonates	Immediate (Acute), Fire
Surfactants - Miscellaneous Amine salts Glycols Phophonates	Immediate (Acute)
Temporary Blocking Agents Benzoic acid (CAS#65-85-0) Naphthalene (CAS#91-20-3) Petroleum wax polymers Sodium chloride (CAS#7647-14-5)	Immediate (Acute)
Viscosifiers Attapulgite Bentonite Guar gum (CAS#9000-30-0) Sepiolite Xantham gum	Immediate (Acute)
Weight Materials Barite (CAS#7727-43-7) Calcium carbonate (CAS#1317-65-3) Galena Hematite (CAS#1317-60-8) Siderite	Immediate (Acute)

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APPENDIX E

GEOLOGY/PALEONTOLOGY

APPENDIX E

GEOLOGY/PALEONTOLOGY

Washakie Formation

The Washakie Formation, the youngest sedimentary deposit of Tertiary age exposed in the project area occurs only in the southwestern extreme of the analysis area near Haystack Buttes. The formation is more extensively exposed south and west of the project area in the center of the Washakie Basin. Two members of the formation separated by an unconformity, the lower Kinney Rim and overlying Adobe Town, are recognized (Roehler 1973, 1991 a-b, 1992 a-c, 1993). Both members accumulated in floodplain environments during and following the final contraction and desiccation of ancient Lake Gosiute in the late middle Eocene when large amounts of volcanic ash, derived from the Absaroka Range in northwestern Wyoming, accumulated in the area. Vertebrate, invertebrate, plant, and trace fossils are abundant in both members. Several fossil mammal bearing localities are known from the formation in the vicinity of the Haystacks (Table A-1). Turnbull (1978) collected fossil mammals from 77 localities in the Washakie Formation throughout the Washakie Basin, beginning in 1956. Unfortunately the results of his work have not been published and is generally unavailable for review. Dr. John Flynn with the Field Museum of Natural History, Chicago, is currently updating Turnbull's work and conducting active field research in paleontology on the formation in the basin.

Green River Formation

In the project area the Green River Formation includes several tongues and members (Roehler 1973, 1991 a-b, 1992 a-c, 1993). From youngest to oldest these include the: (1) Laney Shale Member (Hart Cabin and Laclede Beds); (2) Godiva Rim Member; (3) Wilkins Peak Member (lower part); (4) Tipton Shale Member (Rife and Scheggs Beds); and (5) Luman Tongue (Bradley 1964; Grande 1984, Love and Christiansen 1985; Love et al. 1993; Roehler 1991 a-b, 1992 b-c, 1993; Roehler et al. 1988).

<u>Laney Member</u>. The Laney Member forms the top of the Green River Formation and records in its sediments the greatest expansion of ancient Lake Gosiute followed by its final restriction and desiccation. At its peak the lake in which the Laney accumulated occupied more than 75 percent of the Greater Green River Basin, or an area of about 15,000 square miles. Three rocks units, distinguished by their stratigraphic position and composition have been recognized in the Laney Member. These include, from bottom to top, the oil shale of the Laclede Bed at the base of the member; the overlying sands of the Sand Butte Bed; and the Hart Cabin Bed at the top of the member. The Laclede and Hart Cabin Beds occur in the project area. The Sand Butte Bed occurs further west.

The Hart Cabin Bed forms the top of the Green River Formation in the analysis area and consists of fluvial sediments that accumulated during the final drying up stages of ancient Lake Gosiute. The bed overlies and interfingers with the Laclede Bed and is overlain by and interfingers with floodplain deposits of the Kinney Rim Member of the Washakie Formation.

Table A-1. Fossil Localities within the Greater Wamsutter Area.[1]

7.5 Minute Quadrangle	Geologic Unit/Horizon	UW Locality	Location		
			Section	Township	Range
Creston/Creston Junction	Fort Union	15 unnumbered	2, 3, 11, 35, 36	T19N T20N	R92W
Haystack Flats	Washakie Formation Washakie B	V-55002	25	T27N	R96W
Mexican Flats	Wasatch Formation	V-77003	15	T15N	R93W
Salazar Butte	Washakie Formation Washakie A	V-58011	32	T15N	R94W

[1] Source: Geology Museum, University of Wyoming, Laramie, Wyoming (Database).

Gastropod, bivalve, ostracod, fish, and turtle fossils are locally abundant in the Hart Cabin Bed. Silicified *Goniabasis tenera* shells, known as "*Turitella*" agate is also locally common.

The Laclede Bed consists chiefly of oil shale with lesser amounts of limestone, sandstone, claystone and tuff. It overlies and interfingers with the Wilkins Peak Member, described below and is laterally equivalent to the lower parts of that member. Both units record the renewed expansion and freshening of the waters of ancient Lake Gosiute following its restriction during deposition of the middle part of Wilkins Peak. The thick oil shale that comprises the Laclede Bed accumulated in the deeper parts of the lake during the longest high stand of the lake, which may have lasted as long as 2.5 million years. Silt and sand accumulated in nearshore and shoreline areas of the lake. Linear algal reefs formed extensively in shallow areas of the lake and deposited widespread stromatolite layers. As testament to the longevity of stable conditions in shallows areas of the lake, some individual stromatolites (the remains of calcareous algal reefs) are as much as 25 feet high and 10 feet wide. Widespread oolitic and pisolitic limestone beds accumulated in areas between the reefs and the shore. Laterally the Laclede Bed interfingers with and is replaced by floodplain deposits that comprise the Godiva Rim Member of the Green River Formation, which in turn interfingers with and is replaced by the Cathedral Bluffs Member of the Wasatch Formation. To the north the Laclede Bed interfingers with the Battle Springs Formation. Fossils of gastropods, bivalves, and fish are common in the Laclede Bed. Fossils of the small planorbid gastropod *Gyralus militaris* are extremely abundant and widespread in one particular layer in the Laclede Bed; the layer is recognized as a stratigraphic marker bed, the *Gyralus* Marker. Impressions of plants and insects also occur in some of the shales. Fossil mammals noted by Roehler (1992 c) in a black chert and mollusc bearing locality south of the analysis area may be from the Laclede Bed.

Godiva Rim Member. The Godiva Rim Member consists chiefly of drab-colored sands, silts and muds that accumulated in mud flat and floodplain environments along the eastern margin of ancient Lake Gosiute during the expansion and contraction of the lake. The member interfingers westward with lake deposits of the Laclede Bed. Fossil ostracods, fragmentary fish remains, and trace fossils are common in the member.

Wilkins Peak Member. The Wilkins Peak Member consisting of many layers of cyclic sediments that include in ascending order oil shale, trona, halite, and mudstone. These sediments accumulated at the former lake center and record repeated expansion and restriction of Lake Gosiute. As recognized by Roehler (1991 a-b, 1992 a-c, 1993), the Wilkins Peak Member consists of a lower, middle, and upper unit. Only the lower part of the member is present in the analysis area. The absence of the other parts of the member from the area apparently resulted because of the westward tilting of the Greater Green River Basin during deposition of the Wilkins Peak. This tilting is interpreted to have caused withdrawal of Lake Gosiute westward.

The lower part of the Wilkins Peak consists of sediments that accumulated during 11 cycles of lake expansion and contraction. During its expansive stage, oil shale accumulated widely in the lake basin, while sands and algal limestone accumulated in shallower margins of the lake. During its contractive stage, mudstones and trona accumulated across the entire lake basin. The lake deposits of the lower part of the Wilkins Peak intertongues extensively with floodplain and mountain flank deposits of the Cathedral Bluffs Member of the Wasatch Formation and the Battle Springs Formation toward the edges of the basin.

Fossils of plants, invertebrates, and vertebrates have been reported from the Wilkins Peak Member. Well-preserved fossil leaves, insects and fish are known from several localities in the upper part of the member (Roehler 1993). Fossil plant fragments, fish bones, ostracods, and bird bones (possibly flamingo) have been reported from the lower part of the member along the western side of the Washakie Basin. Hundreds of fossil flamingo bones, apparently the remains of a large nesting colony, may have been collected from a locality that was developed in rocks of the lower part of the Wilkins Peak. This locality found near Oregon Buttes in gray-green, lake claystone (McGrew and Feduccia 1973) was originally described as occurring in the Cathedral Bluffs Member of the Wasatch Formation, but its location in lake sediments may mean the locality is actually from the Wilkins Peak Member.

Tipton Shale Member. The Tipton Shale consists of lake sediments that underlie the Wilkins Peak Member, or in places, the Cathedral Bluffs Member of the Wasatch Formation, and overlie the Niland Tongue of the Wasatch Formation. Laterally, The Tipton interfingers with and is replaced by deposits of the main body of the Wasatch, or Battle Spring Formation. The Tipton has been divided into a lower Scheggs Bed and an upper Rife Bed by Roehler (1992) and both occur in the project area.

The Rife Bed forms the top of the Tipton and consists chiefly of organic rich oil shale, interbedded with a lesser amount of algal limestone, dolomite, sandstone, and mudstone. The oil shale of the Rife accumulated in the deepest parts of the lake during a 500,000 year time period when Lake Gosiute dwindled to about half its former size (about 7,500 square miles) during deposition of the Scheggs Bed. The salinity of the lake must have increased dramatically as evidenced by thin layers of saline minerals such as nahcolite and disseminated crystals of shortite that occur in the upper part of the bed. Algal limestone and sands accumulated in shallower and shoreline areas. Although a few small planorbid gastropod fossils are known from the lower part of the Rife Bed, few fossils are known from higher in the unit. With the exception of these gastropods, algal limestone and a few ostracods, the Rife appears to be barren of fossils.

The Scheggs Bed consists of chiefly oil shale, and lesser algal limestones, sands, and muds that accumulated in lake and lakeshore environments during the first major expansion of ancient Lake Gosiute. The bed overlies the Niland Tongue of the Wasatch Formation and laterally the bed interfingers with and is replaced by the main body of the Wasatch and Battle Springs Formation. At its peak the lake in which the Scheggs Bed accumulated covered more than 75 percent of the Greater Green River Basin, or an area of about 15,000 square miles. Deep lake oil shale in the Scheggs Bed preserves abundant fossils of ostracods and shallow-water lake sediments contain abundant stromatolites, the remains of calcareous algal reefs. The stromatolites exhibit a wide variety of bizarre forms that are related to ecological conditions such as water depth, temperature, salinity, sedimentation rate, as well as other factors. Nearshore and shoreline sediments preserve the fossil remains of gastropods, such as *Goniabasis tenera* and *Viviparus* sp., and the large unionid bivalve, *Lampsilis*. Fish fossils also occur abundantly along outcrops of the Scheggs Bed and at least one fossil mammal locality has been reported (Roehler 1991 a-b, 1992 a-c, 1993). The fossil mammal locality discovered in an ostracodal limestone produced the mold of a jaw of the early horse *Hyracotherium*, with incisors preserved and the impression of molars.

Luman Tongue. The Luman Tongue forms the base of the Green River Formation in the project area and is composed chiefly of organic-rich oil shales, carbonaceous shale, limestone, sands, and muds that accumulated in Lake Luman. The tongue overlies the Ramsey Ranch Member of the Wasatch Formation. At its maximum extent, Lake Luman occupied an area of about 6,650 square miles. Surrounding the sandy lake shore was a narrow area where drab-colored floodplain deposits of the Wasatch accumulated. These deposits interfinger laterally to the north and south with vari-colored (chiefly red) floodplain deposits of the Wasatch Formation. Along the northeastern shore of the lake, deltas were present in which the coarse sands of the Battle Springs Formation accumulated.

Fossils of fresh water molluscs are abundant throughout the Luman and the assemblages of fossils are commonly characterized by the large prosobranch gastropods *Goniabasis tenera* and *Viviparus* sp., and by the large unionid bivalve, *Lampsilis*. Fish, ostracod, and trace fossils are also common in the tongue (Roehler 1991 a-b, 1992 a-c, 1993).

Wasatch Formation

The Wasatch Formation in the project area consists of three recognized members including, from youngest to oldest: (1) Cathedral Bluffs Member; (2) Niland Tongue; (3) Ramsey Ranch Member; and (4) the main body of the formation.

Cathedral Bluffs Member. The Cathedral Bluffs Member forms the top of the Wasatch Formation. It is underlain and interfingers with the Tipton Shale Member and is overlain and interfingers with the Laney and Godiva Rim Members of the Green River Formation. The Cathedral Bluffs Member is composed chiefly of vari-colored (chiefly red) sediments that accumulated in fluvial and upland environments surrounding Lake Gosiute. Deposits of the member interfinger with and are replaced laterally toward the basin center by sediments of the Wilkins Peak Member of the Green River Formation that accumulated chiefly in lake environments. To the northeast the member intertongues with and is replaced laterally by the Battle Springs Formation. In some areas where the intervening tongues of the Green River Formation are absent, the Cathedral Bluffs directly overlies the main body of the Wasatch Formation.

Fossils of plants (wood), vertebrates, and trace fossils have been reported from the Cathedral Bluffs Member throughout the Greater Green River Basin (Morris 1954; Gazin 1962; Honey 1992; Roehler 1991 a-b, 1992 a-c, 1993). Fossil mammals from the member include the teeth and bones of at least 19 genera including marsupials, insectivores, tillodonts, primates, rodents, carnivores, condylarths, dinocerates, perisodactyls, and artiodactyls. The member is well exposed south of Red Desert and known to be fossiliferous. Several nearly complete skeletons of the earliest horse *Hyracotherium,* collected by field crews from the Carnegie Museum by Pop Kaye were apparently found in the member near Dad, Wyoming, but the exact location of the find remains unknown (Gazin 1962; Stuckey 1994).

Niland Tongue. The Niland Tongue consists of drab-colored sands and muds that accumulated chiefly in smaller lakes, ponds, swamps, and floodplains following restriction of the lake in which the Luman Tongue of the Green River accumulated. The Niland Tongue is recognized only in the same areas that the Luman is recognized. Where the Luman is absent, the Niland overlies the main body of the Wasatch and the two are indistinguishable. Where it is recognized, the Niland is overlain by the Scheggs bed of the Tipton Shale.

Fossils of plants, invertebrates and vertebrates and their tracks and traces are known from the Niland Tongue (Roehler 1987). Plant fossils, including the imprints of leaves and stems and carbonized wood are common. Pollen and spores are pervasive in organic-rich sediments. Pollen representing at least 25 genera of land plants have been identified from the tongue. Invertebrate are fairly abundant, with ostracods being the most common invertebrate fossil. Ostracods are pervasive in oil shale and limestone and are often found in association with molluscs. Fossil molluscs comprise two distinctive molluscan assemblages including a *Goniabasis, Viviparus,* and *Plesielliptio* assemblage and a *Biomphalaria, Omalodiscus, Gyraulus* assemblage. The assemblages are important environmental indicators. The *Goniabasis, Viviparus,* and *Plesielliptio* assemblage is diagnostic of onshore and offshore lake environments. Some shale layers preserve coquina layers that are composed chiefly of the turreted prosobranch *Goniabasis.* The *Biomphalaria, Omalodiscus, Gyraulus* assemblage is diagnostic of pond and marsh environments (Hanley 1976).

Fossil specimens of mammals and reptiles occur as isolated bones or teeth and rarely as articulated skeletal parts in sediments accumulated in floodplain and pond environments. Mammals described from the tongue include the remains of at least 15 different genera of insectivore, primate, rodent, carnivore, condylarth, artiodactyl, and perissodactyl. Fish fossils, including the scales and bones of teleosts, the holostean gar-pike *Leposteus*, and the freshwater ray *Heliobatis*, occur in sediments that accumulated in lake environments.

<u>Ramsey Ranch Member</u>. The Ramsey Ranch Member consists of drab-colored oil shale, coal, uraniferous sands and shales that accumulated chiefly in smaller lakes, ponds, swamps, and floodplains that existed prior to the development of Lake Luman. The member has lithologic characteristics of both the Wasatch and Green River Formations and was originally attributed to the Green River Formation (Roehler 1965) because of its apparent accumulation in lake or lake margin environments, but has since

been assigned to the Wasatch Formation. Disarticulated fossil remains of vertebrates, including mammalian bone fragments, are locally abundant in the member (Roehler 1992 a-c, 1993).

<u>Main Body</u>. The main body of the Wasatch Formation consists chiefly of floodplain deposits that overlie the Fort Union Formation of the Paleocene age. The floodplain deposits have two distinct color patterns. Around the basin edges the floodplain deposits range from red to varicolored, with some shade of red dominating. The red coloration appears to be a result of oxidation of iron compounds in well-drained, well-aerated soils that formed in sediments that accumulated in areas of moderate topographic relief. In the central parts of the basin these red floodplain deposits are replaced laterally by green to gray floodplain deposits. The green to gray coloration appears to have been the result of accumulation of sediments in areas that were permanently water saturated where iron compounds were reduced. In addition to floodplain deposits the main body of the Wasatch Formation includes some freshwater limestones that accumulated in ponds

and marshes in low lying areas and some coarse-grained sands and conglomerates that accumulated along the basin margin in alluvial fan environments.

The high paleontologic potential of the Wasatch in southern Wyoming is well known (Covert 1994). In many areas of the basin, the main body of the Wasatch contains local accumulations of the fossils of vertebrates (fish, turtles, crocodiles, birds and mammals), invertebrates (snails and clams), plants, and traces and tracks of these organisms.

Fort Union Formation

The Fort Union Formation is exposed within the project area along Fillmore Creek, south of Creston. There the formation consists of drab-colored sandstone, mudstone, limestone, shale and coal that accumulated in floodplain, pond, and swamp environments during the Paleocene and earliest Eocene. The high potential of the Fort Union Formation to produce scientifically significant fossils of vertebrates, invertebrates and plants elsewhere in the Green River Basin is well documented (Rigby 1980; Winterfeld 1982). Few fossils are known from the area, however. Unpublished paleontology surveys for the Cherokee Mine (Eaton et al. 1978) identified plant and vertebrate fossils at 12 localities along Fillmore Creek. With the exception of the several trunks of fossil trees that were found in upright, growth position at one of these localities, all the fossils identified during the survey were fragmentary and considered to have limited scientific significance.

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APPENDIX F

FISH AND WILDLIFE SERVICE LETTER

United States Department of the Interior
FISH AND WILDLIFE SERVICE
Ecological Services
4000 Morrie Avenue
Cheyenne, WY 82001

IN REPLY REFER TO:

ES-61411
mej/W.02(UPdrill.spl)

January 18, 1994

JAN 24 1993

Ms. Juli Elayne Crane
ECOTONE Environmental Consulting, Inc.
123 East 200 North
P.O. Box 3516
Logan, UT 84321

Dear Ms. Crane:

This responds to your letter of December 27, 1993, received by this office on December 30, 1993, regarding the Union Pacific Resources Company proposal to drill additional gas development wells within the Greater Wamsutter Area in Carbon and Sweetwater Counties, Wyoming. We are providing the species list, as requested. We also have concerns with the following issues and request that they receive full treatment in the analysis of this project.

1. Wetland Impacts: We are concerned that wetlands may be impacted by the proposed project. In meeting its responsibilities for wetland protection and conservation, the Bureau of Land Management (BLM) must assure that proposed activities do not result in the taking of any Federal trust wildlife resources nor lead to the contamination of other water sources. Thus, we recommend measures be taken to avoid or mitigate any wetland losses in accordance with Section 404 of the Clean Water Act, the Fish and Wildlife Coordination Act, Executive Order 11990 (wetland protection) and Executive Order 11988 (floodplain management) as well as the President's goal of "no net loss of wetlands." If wetlands may be impacted by the proposed action, those (wetlands) in the project area should be inventoried and fully described in terms of functions and values. Acreage of wetlands, by type, should be disclosed and specific actions outlined to avoid, minimize, and compensate for unavoidable wetland impacts.

The U.S. Fish and Wildlife Service (Service) recommends that you request assistance from the U.S. Army Corps of Engineers (Corps) to determine whether a Section 404 Clean Water Act permit will be required for the proposed work. Under Section 404 (b) (1) guidelines of the Clean Water Act, the analysis should describe alternative actions which avoid, minimize, and compensate for unavoidable wetland impacts. The Service will participate in review of any application for a Section 404 permit. We advise early consultation with the Service and other appropriate agencies on wetland matters. If wetlands are involved but the Corps determines that an individual permit is not required, the BLM should ensure that the intent of Section 404 of the Clean Water Act is met. Wetland issues should be disclosed and addressed in the analysis even if a Section 404 permit is not required.

2. Endangered Species: In accordance with Section 7(c) of the Endangered Species Act of 1973, as amended (ESA), we have determined that the following threatened or endangered (T/E) species may be present in the project area.

SPECIES	STATUS	EXPECTED OCCURRENCE
Black-footed ferret (Mustela nigripes)	Endangered	Potential resident in prairie dog (Cynomys sp.) colonies.
Bald eagle (Haliaeetus leucocephalus)	Endangered	Migrant
Peregrine falcon (Falco peregrinus)	Endangered	Migrant.
Whooping crane (Grus americana)	Endangered	Migrant.

Although most of the project area lies within the Great Divide Basin drainage, part of the project area appears to fall outside of that area. If your proposed action will lead to water quality degradation or water depletion (consumption) in the Colorado River System, you should include the following species in your evaluation:

Colorado squawfish (Ptychocheilus lucius)	Endangered	Downstream resident of Green River System.
Humpback chub (Gila cypha)	Endangered	"
Bonytail Chub (Gila elegans)	Endangered	"
Razorback sucker (Xyrauchen texanus)	Endangered	"

Candidate species that may occur within the project area are identified below. A list providing more information about Wyoming's candidate species is also enclosed. Many Federal agencies have policies to protect candidate species from further population declines. Our office would appreciate receiving any information available on the status of these species in or near the project area.

SPECIES	CATEGORY*	SCIENTIFIC NAME	EXPECTED OCCURRENCE
Birds			
White-faced ibis	2	Plegadis chihi	wetlands statewide
Ferruginous hawk	2	Buteo regalis	grasslands statewide
Columbian sharp-tailed grouse	2	Tympanuchus phasianellus columbianus	Baggs area, Little Snake R.

Mountain plover	1	Charadrius montanus	grasslands statewide
Long-billed curlew	3C	Numenius americanus	grasslands/wetlands
Black tern	2	Chlidonias niger	wetlands statewide
Loggerhead shrike	2	Lanius ludovicianus	woodlands/shrublands
Fish			
Colorado cutthroat trout	2	Salmo clarki pleuriticus	Little Snake R.
Flannelmouth sucker	2	Catostomus latipinnis	Green & Little Snake Rivers & tribs.
Roundtail chub	2	Gila robusta	Green & Little Snake River drges.
Plants			
Contracted Indian ricegrass	2	Oryzopis contracta	plains & hills of western 3/4 of state

*1 = Federal T/E listing appears appropriate and is anticipated. 2 = Current data insufficient to support listing. 3C = More widespread or abundant than previously believed, or no immediate threats identified.

3. Raptor-Proofing Additions or Improvements to Facilities: Two primary causes of raptor deaths are electrocutions and collisions with power lines. If any part of this project will involve construction of new power lines or modification of existing lines, the Service urges ECOTONE to address in the Environmental Impact Statement (EIS) what precautionary measures will be taken to protect raptors through proper raptor-proofing techniques. Federal Register 49 Section 1729.10, 1984, allows for deviations from REA construction standards for raptor protection. Structures which are designed for raptor protection shall be in accordance with Suggested Practices For Raptor Protection on Power Lines. The State of the Art. Raptor Research Report No. 4, 1981, published by the Raptor Research Foundation, Inc. (also cited in FR 11620, 1984), provided that such structures meet with the National Electrical Safety Code. Authority for these measures resides with Section 9 of the Endangered Species Act of 1973 (as amended), The Migratory Bird Treaty Act and the Bald Eagle Protection Act which protects bald and golden eagles. In the above cited Federal Register publication, the following bulletins are also recommended: REA Bulletin 40-7, National Electrical Safety Code-ANSI C2, 1981 Edition and REA Bulletin 61-60, Powerline Contacts by Eagles and Other Large Birds.

4. Water Quality/Habitat Quality: The Service is concerned with water quality impacts of the proposed project, particularly with respect to their effects on fisheries, migratory birds, and Federally listed threatened or endangered species. The EIS should describe project activities that may affect water quality or that have the potential to expose fish and wildlife to hazardous substances. Such activities may include, but are not limited to: wastewater discharges, transportation of hazardous materials, spills, and evaporation ponds.

Section 7(c) of ESA requires that Federal agencies proposing major construction actions complete a biological assessment to determine the effects of the proposed actions on listed and proposed species. If a biological assessment is not required (i.e., all other actions), the agency is responsible for review of proposed activities to determine whether listed species will be affected. We would appreciate the opportunity to review your determination document.

For those actions where a biological assessment is necessary, it should be completed within 180 days of initiation, but can be extended by mutual agreement between the action agency and the Service. If the assessment is not initiated within 90 days, the list of T/E species should be verified with the Service prior to initiation of the assessment. The biological assessment may be undertaken as part of the agency's compliance of Section 102 of the National Environmental Policy Act (NEPA), and incorporated into the NEPA documents. We recommend that biological assessments include:

1. a description of the project;
2. a description of the specific area potentially affected by the action;
3. the current status, habitat use, and behavior of T/E species in the project area;
4. discussion of the methods used to determine the information in item 3;
5. direct and indirect impacts of the project to T/E species;
6. an analysis of the effects of the action on listed and proposed species and their habitats including cumulative impacts from Federal, State, or private projects in the area;
7. coordination measures that will reduce/eliminate adverse impacts to T/E species;
8. the expected status of T/E species in the future (short and long term) during and after project completion;
9. determination of "is likely to adversely affect" or "is not likely to adversely affect" for listed species;
10. determination of "is likely to jeopardize" or "is not likely to jeopardize" for proposed species;
11. an analysis of the effects of the action on raptors and coordination measures that will reduce/eliminate adverse impacts to raptors;
12. an analysis of direct and indirect impacts to water quality and coordination measures that will reduce/eliminate adverse impacts to water quality;
13. citation of literature and personal contacts used in assessment.

If it is determined that any agency program or project "is likely to adversely affect" any listed species, formal consultation should be initiated with us. If it is concluded that the project "is not likely to adversely affect" listed species, we should be asked to review the assessment and concur with the determination of no adverse effect.

A Federal agency may designate a non-Federal representative to conduct informal consultation or prepare biological assessments. However, the ultimate responsibility for Section 7 compliance remains with the Federal agency, and written notice should be provided to the Service upon such a designation. We recommend that Federal agencies provide their non-Federal representatives with proper guidance and oversight during preparation of biological assessments and evaluation of potential impacts to listed species. Section 7(d) of ESA requires that the Federal agency and permit or license applicant shall not make any irreversible or irretrievable commitment of resources which would preclude the formulation of reasonable and prudent alternatives until consultation on listed species is completed.

We look forward to reviewing the EIS. If you have any questions or need more information please contact Mary Jennings of my staff at the letterhead address or phone (307) 772-2374.

Sincerely,

Charles P. Davis
State Supervisor
Wyoming State Office

enclosure

cc: Director, WGFD, Cheyenne, WY
Nongame Coordinator, WGFD, Lander, WY