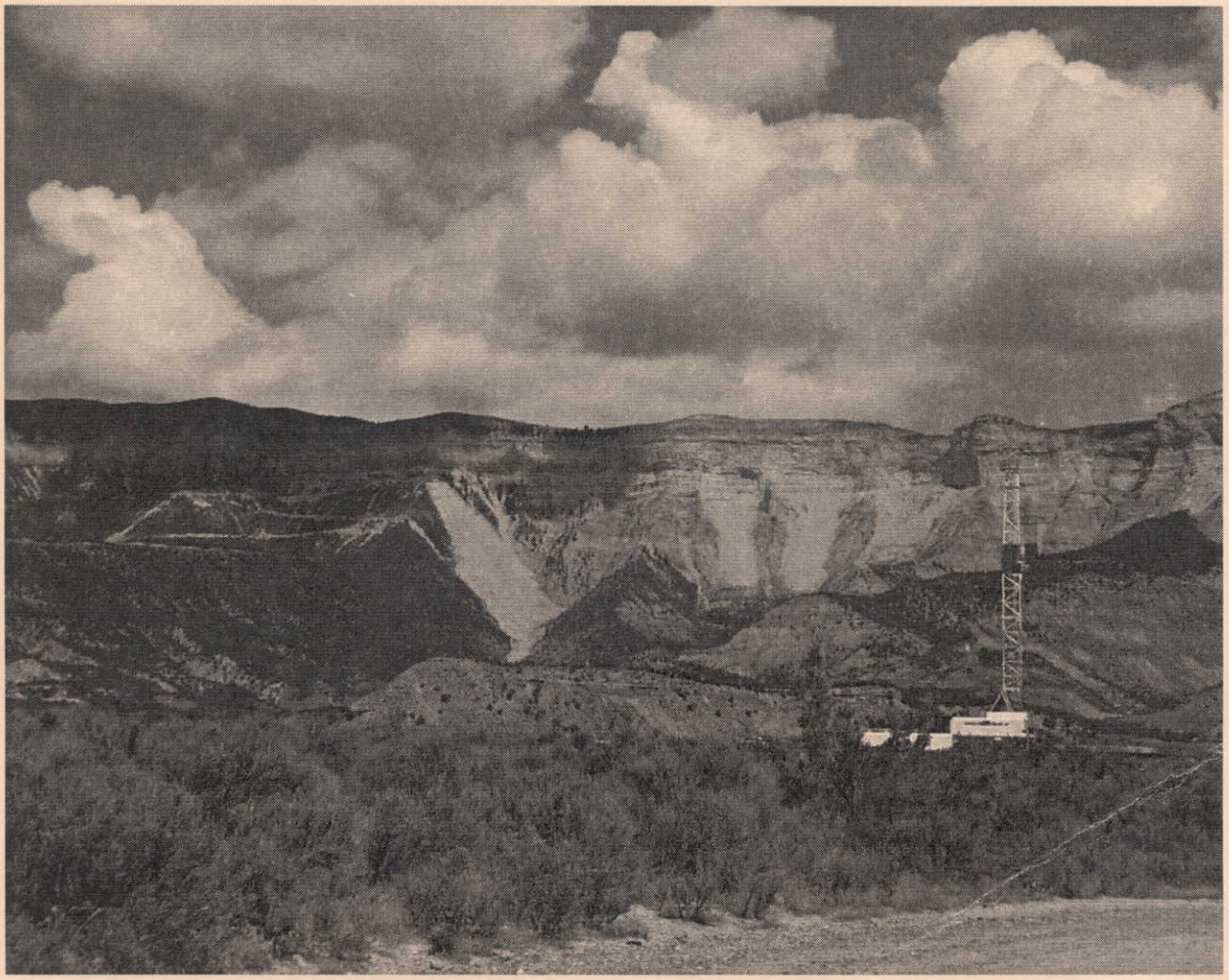
U.S. Department of the Interior
Bureau of Land Management
Colorado State Office

Glenwood Springs Resource Area

Oil & Gas Leasing & Development

Draft Supplemental Environmental Impact Statement

June, 1998



United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Glenwood Springs Resource Area
50629 Highway 6 and 24
P.O. Box 1009
Glenwood Springs, Colorado 81602

IN REPLY REFER TO:

1793 (CO-078)

June 19, 1998

Dear Reviewer:

This Draft Supplemental Environmental Impact Statement (SEIS) is submitted for public review and comment. The Draft SEIS documents the analysis of the potential impacts of changed management of oil and gas leasing and development in the Glenwood Springs Resource Area (GSRA). It supplements an earlier Environmental Impact Statement (EIS) on oil and gas leasing in the GSRA, the Colorado Oil and Gas Leasing EIS (1991). The amount of development activity anticipated in that document was quickly surpassed. This supplementary document analyzes a higher level of potential development and proposes alternative management options. Additionally, it analyzes the impacts of leasing lands in the Naval Oil Shale Reserves (NOSR), public lands that have not before been available for lease. New leasing decisions for the public lands in the GSRA and for the NOSR will require an amendment to the GSRA's Resource Management Plan.

This Draft SEIS was prepared pursuant to the National Environmental Policy Act and other laws and regulations to address possible environmental impacts of continued oil and gas leasing and development of public lands in the GSRA and the NOSR. It is not a decision document. Its purpose is to inform the public of the impacts associated with oil and gas leasing and development on public lands and to evaluate alternative management options. Subsequent to this process, the GSRA will issue a Final SEIS and Record of Decision to adopt any changed leasing and mitigation decisions and amend its RMP.

If you wish to comment on the Draft SEIS, we request that you make your comments as specific as possible. Comments will be more helpful if they include suggested changes, sources or methodologies. Comments that contain only opinions or preferences will not receive a formal response; they will, however, be considered as part of the BLM decision-making process.

The public comment period for this Draft SEIS will be 90 days from the date that the Environmental Protection Agency publishes a Notice of Availability in the Federal Register. Please send written comments to:

Bureau of Land Management
Attn: Steve Moore, Oil and Gas Team Leader
Glenwood Springs Resource Area
P.O. Box 1009
Glenwood Springs, CO 81602

Please keep your copy of this document for future reference. Copies have been mailed to affected government agencies and to those persons who responded to scoping or otherwise indicated that they wished to receive a copy. Copies of this Draft SEIS are available for public review at the GSRA office at 50629 Highway 6 and 24 in Glenwood Springs, and at the Grand Junction District Office of BLM, 764 Horizon Drive, Grand Junction. An open house is planned during the review period but the date and location have not yet been selected. The open house will be announced in local papers several weeks ahead of time.

Sincerely,

Michael S. Mottice

Michael S. Mottice
Area Manager

DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT
OIL AND GAS LEASING AND DEVELOPMENT
IN THE GLENWOOD SPRINGS RESOURCE AREA
GARFIELD COUNTY, COLORADO

[x] Draft Final [ ]

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

This is the Draft Supplemental Environmental Impact Statement and Draft Resource Management Plan Amendment on oil and gas leasing in the Glenwood Springs Resource Area, Colorado. Included in the document is an analysis of leasing lands in the Naval Oil Shale Reserves which have not been available for leasing before. The Proposed Action includes lease stipulations that would minimize the adverse impacts of oil and gas development activities. Subsequent to the EIS process, an amendment to the Glenwood Springs Resource Management Plan will incorporate any new leasing decision into the plan.

For further information, contact:

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Glenwood Springs, CO 81602

Date released to the public: June 19, 1998

Date Comments due: September 17, 1998

Glenwood Springs Resource Area
Oil and Gas Leasing and Development

Supplemental Environmental Impact Statement

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Executive Summary

Introduction

In November 1991, the Bureau of Land Management (BLM) amended the Resource Management Plan (RMP) for the Glenwood Springs Resource Area (GSRA), as described in the Colorado Oil and Gas Leasing and Development Final Environmental Impact Statement (FEIS) of January 1991.

When the original RMP amendment was prepared, only limited oil and gas development had occurred in the GSRA. However, the level of development activity began to increase soon after completion of the FEIS and was concentrated in a relatively small area along the Interstate 70 corridor from Silt to Parachute. This higher-than-expected rate of development raised questions about the impact analysis in the FEIS and its continued validity. Additionally, as many as 25 wells per year have been approved on BLM land in recent years and such rates are expected to continue into the future.

Therefore, a decision was made to complete a new evaluation of the impacts of oil and gas leasing and development on BLM lands and federal mineral estate in the GSRA. On April 21, 1997, the GSRA published in the Federal Register a Notice of Intent (NOI) to begin a Supplemental Environmental Impact Statement (SEIS) on oil and gas leasing and development and initiated a public comment period.

While the SEIS was being prepared, Congress passed a law which called for the transfer of all 56,000 acres of the Naval Oil Shale Reserves (NOSR) near Rifle, Colorado from the Department of Energy (DOE) to the Department of the Interior (DOI), and mandated that the developed portion of the NOSR be offered for lease of its oil and gas reserves within one year. BLM published an additional NOI to include the NOSR in the SEIS on March 17, 1998.

Location

The FEIS included the entire GSRA (568,000 acres of public land from Edwards to DeBeque and from Aspen to Toponas) as well as four other Colorado BLM resource areas.

This SEIS will also include the entire resource area, but will focus on the area having a high oil and gas potential, referred to as Region 4. This area contains 568,548 total acres. BLM lands, federal mineral estate under privately owned surface (split estate) and the NOSR lands, formerly managed by the Department of Energy (DOE), comprise 200,937 acres, or 35 percent of Region 4.

DOE drilled and operates 30 wells in the southernmost portion of the NOSR. These lands are referred to in this SEIS as the NOSR Production Area.

Purpose of the SEIS

The purpose of the SEIS is: 1) to comply with the FEIS mandate for a review of environmental effects when the number of wells exceeded the RFD; 2) to provide public disclosure of the impacts of a level of development greater than originally anticipated; 3) to provide an improved information base for managing gas development impacts; 4) to prepare a set of management objectives or standard operating procedures that could be used to manage future oil and gas development; and 5) to permit the review and modification of lease stipulations that could be applied to future leases or used as COAs on existing leases; 6) to develop mitigation measures to be applied to new leases in the NOSR.

This SEIS does not authorize the construction of any individual well locations. A separate Environmental Assessment (EA) would be prepared in the future for individual Applications for Permits to Drill (APD). EAs

for APDs are more site-specific and include on-the-ground inventories for cultural resources and sensitive plant and animal species. The EA process includes an on-site exam in which the BLM and operator and interested stakeholders view the proposed well location in the field to make appropriate adjustments to the location or design of the well pads and roads.

Future EAs will tier to this SEIS as much as possible to avoid duplication of paperwork. The EAs will focus on site-specific, on-the-ground issues and will not deal with those larger issues addressed in the SEIS.

Objective of the SEIS

The overall objective for the SEIS is the same as the objective in the FEIS; to facilitate orderly, economic, and environmentally sound exploration and development of oil and gas resources using balanced multiple-use management. BLM is not proposing changes to the major decisions in the FEIS, namely that: 1) the entire Federal mineral estate in the GSRA (now including portions of the NOSR), except Wilderness Study Areas (WSAs), would be open for oil and gas leasing and development; 2) BLM would apply Lease Stipulations, No Surface Occupancy stipulations, Timing Limitations, Controlled Surface Use Stipulations and Lease Notices as appropriate to all new leases, and; 3) BLM will develop appropriate Conditions of Approval (COAs) for all APDs for leases issued prior to the FEIS provided the COAs are consistent with lease rights granted.

Alternatives

Issues and concerns have been identified during the two public scoping periods for this SEIS, through public comments noted by the BLM during the processing of individual APDs, and at various public meetings on the subject of oil and gas development in Region 4 over the past several years.

Three alternatives were developed to address the issues. They include a Continuation of Current Management (CCM) Alternative, a Maximum Protection (MP) Alternative and a Proposed Action (PA).

The alternatives are defined in terms of the tools available to BLM to manage and mitigate the impacts of oil and gas leasing and development. Those tools are: the Standard Terms and Conditions which are attached to every oil and gas lease, in particular lease term Section 6, Conduct of Operations, which is intended to minimize adverse impacts and under which terms an operator's activities can be postponed for up to 60 days or relocated up to 200 meters; Lease Stipulations, including No Surface Occupancy (NSO), Timing Limitations (TL) and Controlled Surface Use (CSU); Conditions of Approval (COA) which may be applied at the time of development, and; Lease Notices, which alert lessees to the need for inventories or other special requirements. In general, an NSO stipulation is the most restrictive constraint attached to a lease, enabling the Authorized Officer (AO) to deny a well location on a lease if the condition of the stipulation cannot be met. A CSU stipulation is less restrictive, usually requiring special design and siting considerations (which sometimes may include relocation beyond the 200 meters allowed under the Standard Lease Terms). TL stipulations are very restrictive in that no activities are permitted, but of course the restriction is temporary.

Continuation of Current Management Alternative (CCM)

The CCM Alternative in this SEIS is the same as the Proposed Action in the FEIS. It includes 27,280 acres of no leasing in four WSAs, about 175,000 acres of NSO stipulations for the protection of wildlife, watershed and recreation values, a group of TL stipulations for the protection of wildlife, and CSU stipulations the protection of coal mines, riparian, watershed and Visual Resource Management (VRM) values.

Maximum Protection Alternative (MP)

The MP Alternative includes all the elements of the CCM Alternative and additional provisions aimed at maximizing the protection of surface resources and minimizing adverse environmental impacts, regardless of the effect on gas production. The alternative adds more stringent restraints on operations in riparian areas, protects wildlife seclusion areas, provides stricter control of surface disturbing activities when slopes exceed 25 percent, and extends and more closely defines protection of the visual resource. It would result in reduced production of gas from the NOSR Production Area as stipulations in the alternative would make certain locations impossible or too expensive to develop.

Proposed Action (PA)

The PA is based on the concept of establishing management objectives and "best management practices" (standard operating procedures), independent of lease rights already granted. Lease rights would be considered at the time such practices or standards are actually applied on-the-ground to site-specific APDs. It is recognized that some of these practices may be inconsistent with certain lease rights already granted and therefore would have to be modified or waived on a case-by-case basis.

It is hoped that the PA represents a set of management goals and desired outcomes such that BLM, the leaseholder and other stakeholders could discuss development proposals and seek to accomplish the intent of the Proposed Action whenever possible.

Alternatives Considered but Not Included

No Leasing Alternative. This alternative was not included because the FEIS established that all lands except WSAs would be available for oil and gas leasing. This is consistent with BLM policy and the Mineral Leasing Act. Moreover, nearly all public lands in Region 4 have already been leased. The bill transferring the NOSR to BLM mandated the NOSR be leased as well.

Maximum Production Alternative. This alternative was not included because the FEIS evaluated a Standard Lease Terms and Conditions Alternative which essentially provides for the legal minimum restrictions on oil and gas operation, thus accomplishing the intent of a Maximum Production Alternative. The FEIS concluded that this alternative was not adequate and that additional protective measures were needed.

No Action Alternative. The No Action Alternative would amount to no change in the way BLM currently manages oil and gas operations. The Continuation of Current Management Alternative included in this SEIS adequately accomplishes the intent of a No Action Alternative so the No Action Alternative was not included in the SEIS.

Issues

Following are the primary issues discussed in the SEIS and a summary of the way in which the three alternatives address the issue.

Lease Rights. Except for the NOSR Production AREA, most of the high potential gas production area in the GSRA is already held by oil and gas leases which were issued prior to the completion of the FEIS. Those leases transferred rights to the oil and gas deposits, limited by the standard terms and conditions attached to the lease. This situation constrains the ability of BLM to require certain mitigation measures on APDs, thus some of the mitigation approved in the FEIS has been unavailable to the GSRA.

It should also be noted that BLM has chosen not to implement some mitigation measures (e.g., habitat replacement, wellpad access restrictions, mandatory telemetry monitoring at well heads) proposed in recent years in anticipation of the comprehensive review of environmental effects

in this SEIS. It was thought that the SEIS would provide better information upon which decisions concerning those proposed mitigation measures could be based.

The constraint on BLM's ability to require certain mitigation measures has not changed with the preparation of this SEIS. The decisions in this SEIS could only be implemented on existing leases as COAs where they would not adversely affect lease rights or when compliance by the operator was voluntary.
BLM will attempt to apply the stipulations and COAs adopted in this SEIS to all future APDs. Many of these measures are considered consistent with lease rights or BLM will pursue implementation by the operator on a voluntary basis. A few measures will likely need to be discussed on a case-by-case basis to determine the impacts of that measure on lease rights. It is possible that some measures would not be implemented.

The MP Alternative places the most restrictions on oil and gas activities and the CCM Alternative places the fewest. Thus, certain components of the MP Alternative are more likely to be considered inconsistent with lease rights on old leases than the CCM Alternative.

An analysis of the mitigation measures described in this SEIS for consistency with lease rights was not completed because such an analysis is best conducted on a case-by-case basis so that site- specific factors can be considered.

The leases for the NOSR Production Area (portions to be leased in November, 1998) will contain the mitigation measures described in this SEIS so there will be fewer lease rights issues for those lands as well as other lands.

Reclamation and Soils. Reclamation in arid environments is a very slow process, leading to public perceptions that BLM has required too little of the operator in this regard. The risk of unsuccessful reclamation and erosion are higher when disturbance occurs in steep and erosion-prone soils, as is sometimes the case in Region 4. The topography in Region 4 often forces a choice between impacting the riparian zone or an erosive, steep hillside adjacent to the riparian zone.

The three alternatives control activities on steep slopes and erosive soils to varying degrees in order to decrease soil erosion and increase the likelihood of successful reclamation. The CCM Alternative establishes performance objectives and standards with a CSU on fragile soils and slopes greater than 40 percent. The MP Alternative establishes an NSO on highly erosive soils and slopes greater than 35 percent and sets standards for pad size and cut and fill slopes on slopes greater than 25 percent.

The PA establishes an NSO on slopes greater than 35 percent, with a few exceptions for short segments of road or small portions of the wellpad. Based on engineering considerations, a 35 percent slope is often considered at or near the upper limit for road and wellpad construction.

Of particular note in the PA is a CSU designed to reduce the overall amount of ground disturbance and increase reclamation success by establishing design standards for wellpads on slopes greater than 25 percent. It is at this slope that reclamation becomes increasingly more difficult, sites are more prone to erosion, road and wellpad construction becomes more difficult and overall site disturbance begins to increase substantially for a given wellpad unless special design measures are incorporated.

All three alternatives incorporate the 1997 GSRA Reclamation Policy which establishes reclamation goals and objectives, calls for the operator to report on reclamation progress, and establishes reclamation considerations in environmental assessments prepared for APDs.

Riparian Community. Riparian zones include some of the most productive and valuable

vegetation communities in Region 4; at the same time, topography sometimes dictates that potential well sites and roads be placed directly in or adjacent to these areas. How extensively have riparian zones been affected and how can they be better protected?

The CCM Alternative uses an NSO to restrict oil and gas development beyond the edge of the riparian vegetation zone. The MP Alternative establishes an NSO (with exceptions) for an area 500 feet beyond the outer edge of the riparian zone.

The PA uses an NSO to protect the actual riparian vegetation and establishes a CSU on an area 500 feet on either side of the riparian vegetation. Such a CSU gives the BLM greater control of oil and gas operations in important riparian areas without precluding natural gas development.

Wildlife. Many species of wildlife are affected by the loss of habitat and disturbance from human activities, especially at critical times. Construction of roads and wellpads removes vegetation and reduces the utility of the affected habitat. More importantly, new roads and new traffic on existing roads may displace wildlife from a habitat area.

The MP Alternative establishes wildlife seclusion areas, protected with an NSO. Through the use of COAs, the MP Alternative would require well monitoring via remote sensing, restrict travel during certain times of the day and require habitat improvement projects in critical habitat areas.

Through COAs, the PA encourages operators to work with CDOW to establish guidelines for their employees "working in wildlife habitat." More notable, the Proposed Action also requires operators to implement measures to reduce impacts on wildlife and wildlife habitats. Such measures could include habitat improvement projects and the use of remote sensing to reduce human disturbances during critical periods in important wildlife habitat areas, and would be developed in cooperation with the operator, the Colorado Division of Wildlife and BLM as part of the approval process for APDs.

The PA also acknowledges the cumulative impacts on wildlife habitats from roads and the associated human use of those roads related to the many residential, commercial, and recreational activities occurring in Region 4. The direct and indirect impacts of the transpiration system are substantial and the Proposed Action, like the MP Alternative, identifies wildlife seclusion areas in which BLM would like to avoid further habitat impacts associated with road construction.

Visual. The surface disturbance caused by gas development alters the natural landform so that the visual character is affected. The production facilities left on the completed wellpad also alter the landscape character. Much of the development occurs in the I-70 corridor and hence is visible to many visitors and travelers. Residents of the area often view the disturbance from their homes.

As the population of Region 4 increases, lands throughout the area continue to be subdivided for rural homesites. The views from these homes will continue to be affected by oil and gas and homesite development not only on lands nearby but lands sometimes 5 to 10 miles away. It is impractical to suggest that all views can be protected to the same degree and BLM management objectives identify certain viewsheds as worthy of greater protection than others.

The CCM Alternative provides an NSO to protect Class II Visual Resource Management (VRM) areas. The MP Alternative establishes an NSO on certain slopes over 25 percent and protects the Roan Cliffs area with an NSO. A CSU on slopes less than 25 percent is used to provide additional protection to portions of the I-70 viewshed.

The PA provides an NSO to protect slopes 25 percent or greater in the I-70 viewshed and protects the scenic Roan Cliffs area. Both areas are considered to be regional in importance, primarily based on the number of visitors who view the outstanding scenic qualities of the area. A CSU protects portions of several other viewsheds as seen from certain residential areas in Region 4, by requiring special design considerations to reduce visual impacts. The CSU however, does not include a provision that operations could be moved more than 200 meters in those instances.

Social and Economic. Gas drilling is an economic activity that produces an essential energy fuel and is generally considered to have a positive affect on local economies. However, the degree of activity may affect the residential character of the area and adversely impact local infrastructure, in particular, the road system.

The alternatives provide a range of restrictions that will affect the total number of wells drilled on public lands, the amount of natural gas produced and the distribution of receipts to local governments.

The MP Alternative and the PA each establish a "working in residential areas" COA to require the operator to reasonably address issues in residential areas. Specific measures to address site-specific concerns would be developed upon consideration of individual APDs. The MP Alternative provides a 1/4 mile buffer around residences. Both the PA and MP Alternative require the operator to prepare an Emergency Communication Plan.

Air Quality. Emissions discharged from the wellhead in venting and flaring activities and dust and exhaust from construction and maintenance activities have been identified as issues of concern.

There have been numerous general statements from the public expressing concern for the nuisance (odor, dust, smoke, exhaust emissions, poor visibility) posed by oil and gas activities. In addition, formal complaints in which citizens experienced breathing difficulties, eye irritation and nausea have been noted. Since operations on public land are often removed from residences, most such complaints involve operations on private lands.

All three alternatives provide for oil and gas development operations consistent with State and Federal air quality standards.

The MP Alternative establishes a 1/4 mile buffer around residences and requires the operator to conduct air quality monitoring if necessary. The PA Alternative adopts a "working in residential areas" COA which requires the operator be responsive to a variety of issues related to developing natural gas in residential areas. The COA is designed to avoid or reduce potential conflicts and facilitate discussion between the operator, the BLM, neighbors and other stakeholders to find a reasonable and equitable solution to related complaints.

Groundwater. In the summer of 1997, natural gas and drilling fluids from an oil and gas well on private mineral estate migrated into a domestic water well approximately one mile away. There are concerns that such problems could develop again on other wells.

BLM is committed to protecting all useable groundwater. The MP Alternative provides for the operator to participate in groundwater monitoring if necessary and establishes a CSU to require the operator to prepare a groundwater risk assessment for wells in the overpressure zone. Since BLM conducts groundwater analysis for each APD, the PA does not include any operator requirements for risk assessments.

All three alternatives provide for oil and gas operators to take whatever actions are necessary to protect useable groundwater.

Project Rulison. On September 10, 1969, a 43 kiloton nuclear device was detonated six miles

southeast of Parachute, Colorado to fracture rock and release gas in a formation 8,426 feet below the surface. The public is concerned about possible radioactive contamination from Project Rulison. BLM has thoroughly investigated all available data on the project. Most of the lands in the immediate vicinity of the project are privately owned.

While the CCM Alternative does not address Project Rulison, the MP Alternative would not permit leasing within one mile of the project. Both the MP and PA require that all wells within three miles of Project Rulison be subject to oversight measures established by the Colorado Oil and Gas Conservation Commission (COGCC).

Transportation Systems. Well drilling rigs and support equipment travel from site to site and may affect local traffic patterns, damage roads, and create safety issues. This issue is primarily related to County roads, under the jurisdiction and control of Garfield County. County roads tend to be narrow, winding roads, designed for farm-to-market , light-volume, light-duty traffic. Oil and gas equipment often exceeds the design of the roads, creating safety issues and requiring extra maintenance. BLM requires that the operator obtain all necessary local permits, including the hauling permits required by Garfield County.

Hazardous Materials. In the summer of 1997, workers at the Anvil Points Landfill complained of irritating emissions during the flaring of a nearby gas well on split estate. Operations at that well were subsequently modified to correct the problem, but complaints about the adequacy and timeliness of the operator and BLM's response suggest a need for greater attention to such matters in the future. For a discussion of hazardous materials management in the Grand Junction District, please see Appendix L.

Environmental Consequences

Assumptions

The Reasonable Foreseeable Development (RFD) is an assumed level of activity that is used in the analysis of environmental consequences. The RFD is based on the average activity for the last 5 years. Over the 20 year period of analysis, this would amount to 1,200 additional wells drilled on fee and federal mineral estate.

During the last 5 years, wells drilled on BLM-administered mineral estate in Region 4 made up about 22 percent of the total. For the RFD, it is assumed that the BLM portion of future development will be 25 percent, or 300 wells over the 20 year period.

Several other assumptions were made that affect the analysis of environmental consequences: gas development activity would be most intense in those areas that have seen the most activity to date; much future activity will be filling in between already developed sites; less dense, but continuous development would radiate out from these areas of concentrated activity; market conditions and gas prices were assumed to have cyclic ups and downs which would average out over the 20 year period.

Threatened and Endangered Plants and Animals

To date, few BLM-approved oil and gas activities have affected threatened and endangered plants and animals. Federal and State listed threatened and endangered species would continue to be protected under all alternatives. Biological inventories for special status plants and animals would be required prior to any surface disturbing activities. As the extent of oil and gas development on public lands increases, it is more likely that certain important plants or plant communities not

protected by the Endangered Species Act or listed on state or federal sensitive species lists could be affected.

Riparian and Wetlands

There are approximately 3,525 acres of riparian habitat in Region 4, about 12 percent on public land. On all lands, 41 percent of the riparian areas are already affected by existing roads (not simply to oil and gas roads). About three percent of the total riparian area in Region 4 have been affected by BLM oil and gas-related activities.

Oil and gas activities have probably caused little impact to riparian areas in Region 4 when compared to other types of human disturbance. Most of the riparian areas are on private lands not controlled by BLM or subject to the mitigation measures proposed in this SEIS. Throughout Region 4, an additional 34% of the riparian areas might be affected over the 20 year planning period. Added to current levels of impact, more than 70% of the riparian areas in Region 4 could ultimately be affected.

The cumulative impact to these important areas suggests the need to minimize additional impacts to already affected riparian areas and to protect those areas still generally undisturbed.

Wildlife

Elk and mule deer are the wildlife species most adversely affected by oil and gas development in Region 4. Adverse effects are primarily associated with the loss of habitat effectiveness which extends well beyond the boundaries of the actual site disturbance. This loss of habitat effectiveness occurs because human activities in wildlife habitats displace wildlife. This is especially important in winter range. Some impacts may be offset by mitigation efforts that either improve habitat or reduce the level of human disturbance.

The direct effect of oil and gas development on deer and elk habitat in Region 4 to date amounts to less than one percent of total mule deer and elk winter range. However, the total indirect, or displacement effect, of all roads from all uses (I-70, residential, state and county roads, towns, oil and gas development, etc) on mule deer winter range was estimated at 151,590 acres, or 55 percent of the mule deer winter range in Region 4. The portion of this impact attributable to gas development on public mineral estate was estimated at 2.7 percent. Elk winter range affected by all uses amounts to 245,357 acres, or 94 percent of the total elk winter range in Region 4. About three percent of this total is attributable to gas development on public mineral estate.

The cumulative effect on mule deer habitat from the future development of 1,200 wells in Region 4 would include a direct impact on an additional 3,590 acres and an indirect effect on an additional 28,200 acres of winter range, representing about 11 percent of the total mule deer winter range in Region 4. The cumulative effect of future oil and gas development on elk winter habitat would be a direct impact on 2,162 acres and an indirect impact on 14,628 acres, representing approximately 20 percent of the elk winter range in Region 4.

Along with future oil and gas development, the overall cumulative assessment must consider on-going development associated with residential uses of land in Region 4. The continual increase in the road system in important winter habitat and the corresponding reduction of habitat effectiveness will likely result in declining herd numbers unless effective mitigation can be applied to protect and improve the habitat. This suggests the need to also consider measures to protect some of the few remaining areas of high quality wildlife habitat.

Soils

The total effect on the soils from oil and gas development on BLM-managed mineral estate in

Region 4 has been minimal, affecting less than one percent of the soils in Region 4. This is due in large part to well established mitigation and reclamation practices that minimize the effects of surface disturbance.

Over 20 years, the cumulative effect on soils from oil and gas development under all alternatives would be minimal. While construction of 1,200 additional wellpads may result in a large amount of soil being moved locally in the short-term, any increases in regional soil erosion and resulting sedimentation would not be distinguishable from natural variation in the area.

Surface Water

Oil and gas activities have resulted in minimal adverse impacts to water resources to date. The short-term impacts to surface water are primarily an increase in sediment and, potentially, salinity that occurs while the surface is disturbed. Surface water is most susceptible to sediment and salt yield while facilities are under construction. Within days following completion of drilling, measures to mitigate the disturbed site are implemented. Generally, sediment and salt yield are slightly higher on recently rehabilitated sites and decrease over time to a negligible level.

The future impacts to surface water would be about the same for all alternatives. The 1200 new wells would cause a surface disturbance of an estimated 4,080 acres. Approximately 1,020 acres of public land and 3,060 acres of private land would be disturbed. This surface disturbance would result in a short-term increase in sediment and salinity in surface waters and a potential increase in peak flows. Most of the area being developed is dry with runoff only occurring occasionally throughout the year. When runoff events do occur, sediment, salt, and other pollutant increases coming from oil and gas facilities are indistinguishable from those coming from undisturbed areas in the rest of the basin. The intensity and duration of these impacts would be reduced by effective mitigation including water bars for roads, siting locations and roads away from drainages, maintaining riparian buffers, and others.

Visual

Visual impacts were evaluated by analyzing the visual sensitivity of the locations of wells and related access roads from several viewpoints: I-70, Battlement Mesa, Parachute Creek, Holms Mesa, the town of Rifle and Highway 13. The impact of gas development activities generally depends on the character of the landscape and the visual contrast of modifications to the landform and vegetation features, and the size, color and shape of structures. During drilling operations, newly constructed pads and roads with bare cut and fill slopes are noticeable and attract attention. The drilling rig and related equipment, flaring operations and associated traffic also attract attention and are noticeable from a distance.

With the assumed future development and a continued pattern of well site locations, all of the viewsheds will be affected by a noticeable increase in visual impacts from gas development. Visual impacts of development under new leases in the NOSR Production Area in the I-70 viewshed would be reduced by a NSO stipulation that limits the visual impact of development on slopes over 25 percent in the I-70 viewshed.

Visual impacts of gas development on non-BLM land will be noticeable and attract attention and are likely to dominate the immediate scenery in some places because a lot of the private lands are located in the foreground view.

Groundwater

The overall potential for contamination of usable water zones and domestic groundwater from BLM-approved gas drilling operations is considered to be very low under all alternatives for several reasons: the requirements that operators isolate and protect usable water zones;

the relatively few domestic water wells on or near public lands; and the limited amount of water-bearing zones on public lands

Transportation

Under all alternatives, BLM will continue to require appropriate measures of the operator for construction and maintenance of roads on BLM lands and to require that the operator obtain all necessary local permits, including the hauling permits required by Garfield County. Such measures will do little to address the issues raised by citizens concerning the Garfield County road system.

Social and Economic

The oil and gas industry is a very visible economic presence in parts of Garfield County but does not, overall, support a large portion of the jobs in the county. Given that the BLM-controlled oil and gas activity in Region 4 is only about 20-25 percent of the total activity and that the variation in number of wells drilled on public lands under each alternative is not substantial, it is likely that any shortage of well drilling opportunities on public lands would be made up by drilling on private lands, especially in the short term. Thus, little impact to local economies is expected under any of the alternatives.

Minerals

Each well represents about 1.5 BCF of natural gas and so every well location denied by BLM represents a potential loss of this production and associated revenues. This is of particular concern on the NOSR as the fewer future well sites permitted on these lands the longer the time needed to recoup the U.S. Government's investments in the wells and pipelines already on the property and, therefore, the longer it would be before any revenue would be shared with the State of Colorado under the Minerals Leasing Act. Due to proposed restrictions to be placed on gas well locations in the NOSR Production Area, it is estimated that, for the NOSR, the PA would result in the loss of five well sites, potentially producing 7.5 BCF of natural gas, and the MP Alternative would result in the loss of 15 well sites, potentially producing about 22.5 BCF of natural gas. Some or all of the production loss could eventually be offset by directional drilling from other locations, but operator costs would be increased. Increased operator costs would not affect production and revenues until such costs became prohibitive and the operator chose not to drill. No alternative is expected to affect substantially the overall amount of oil and gas drilling activity in Region 4.

Project Rulison

Evaluation of current data from extensive pre- and post-detonation technical studies and evaluations, reports concerning site cleanup and remediation, and monitoring data indicates that any radionuclides that may be present are contained within the chimney cavity and fracture zone. The probability of radionuclides migrating from the chimney cavity and fracture zone created by the nuclear detonation is extremely low. This is due to the limited chimney cavity and fracture zone radius, the lenticular geometry of the Williams Fork sandstones, as well as their low permeability and porosity, and the lack of contaminated gas left in the cavity and fracture zone.

Based on review of available date, BLM has concluded that radioactive materials were most likely confined within the cavity and contained within the 40-acre spacing unit of the well.

Air Quality

No significant, adverse impacts to air quality are anticipated from implementation of any of the alternatives. Localized short-term increases in particulate matter, carbon monoxide, nitrogen dioxide, and ozone concentrations would occur, but maximum concentrations would be well below applicable ambient air quality standards.

Similarly, hazardous air pollutant concentrations would be well below standards, and the related short- and long-term cancer risks (to well rig operators and nearby residences) would be below significance levels.

While all alternatives require operations be consistent with air quality standards, it is recognized that during some time periods mostly associated with constructing and preparing gas wells to go "on-line" for production, that some people will find the operations irritating and annoying. Others with certain chemical sensitivities or breathing difficulties may actually find the operations unhealthy.

Consultation and Coordination

The Bureau of Land Management (BLM) in its Glenwood Springs Resource Area, Grand Junction District and Colorado State Offices has an ongoing working relationship with the U.S. Forest Service, the Colorado Oil and Gas Conservation Commission and the Colorado Division of Wildlife. That working relationship has continued throughout the development of this document. Garfield County participated in identifying issues and potential solutions. Consultation with the U.S. Fish and Wildlife Service on Threatened and Endangered Species was initiated during the FEIS, continued through this process, and will continue throughout oil and gas development in Region 4. As described in Chapter 1, the GSRA had numerous and frequent interactions with residents of the area, and with several organized groups, in particular the Battlement Mesa Service Association and the Grand Valley Citizens' Alliance.

Chapter One

PURPOSE AND NEED

1.1 Introduction

In November 1991, the Bureau of Land Management (BLM) approved a Record of Decision (ROD) to amend the Resource Management Plan (RMP) for the Glenwood Springs Resource Area (GSRA), as described in the Colorado Oil and Gas Leasing and Development Final Environmental Impact Statement (FEIS) of January 1991. That RMP amendment superseded previous oil and gas leasing decisions in the Glenwood Springs RMP. The RMP amendment was prepared under the regulations for implementing the Federal Land Policy and Management Act (FLPMA) of 1976 (43 CFR 1600), in compliance with the National Environmental Policy Act (NEPA) of 1969.

When the original RMP amendment was prepared (1989-91), only limited oil and gas development had occurred in the GSRA. In the previous 30 years, about 80 wells had been drilled on federal mineral estate. The Reasonable Foreseeable Development (RFD) scenario used in the FEIS forecasted 90 wells for the entire GSRA, which seemed a likely level of development for the next 20 years. However, in the high potential area of the GSRA described as Region 4 (Map 1-2), the level of development activity began to increase soon after completion of the FEIS. Although 72 wells had been anticipated for Region 4 over a 20 year period, that number has been reached in only eight years. This higher-than-expected rate of development raised questions about the impact analysis in the FEIS and its continued validity. For example, the increased rate of development and its concentration in a localized portion of the GSRA changed the extent and the nature of some of the impacts caused by gas development. In particular, impacts that would seem to be influenced by more intense development included increased oil and gas truck traffic, greater impacts on visual quality in an area with a high traffic volume and a number of communities and residences, and the effect of oil and gas development on big game winter range.

The FEIS, page 1-6, stated that when the number of wells identified in its RFD scenario had been authorized, BLM would prepare an environmental analysis to determine if the impacts identified in the FEIS had been exceeded. BLM concluded that in some respects the impacts assessed in the FEIS had not been reached. The total surface disturbance associated with the 90 wells in the RFD was projected at 1,090 acres, or about twelve acres per well. In fact, surface disturbance resulting from the wells approved to date has been averaging only about 3.4 acres per well. If surface disturbance were the only criterion, the evaluation in the FEIS would have sufficed for over 300 wells. However, development was concentrated in a relatively small area along the Interstate 70 corridor from Silt to Parachute in a pattern that was denser than implied in the FEIS. Additionally, as many as 25 wells per year had been approved on public land in recent years, and such rates are expected to continue into the future. This exceeds the rate analyzed in the FEIS.

Therefore, a decision was made to complete a new evaluation of the impacts of oil and gas leasing and development on public lands and mineral estate in the GSRA. On April 21, 1997, the GSRA published in the Federal Register a Notice of Intent to begin a Supplemental Environmental Impact Statement (SEIS) on oil and gas leasing and development and initiated a public comment period.

1.2 Purpose and Need

The purpose of the SEIS is to: 1) comply with the FEIS mandate for a review of environmental effects when the number of wells exceeded the

RFD; 2) provide public disclosure of the impacts of a level of development greater than originally anticipated; 3) provide an improved information base for managing gas development impacts; 4) prepare a set of management objectives or standard operating procedures that could be used to manage future oil and gas development; and 5) permit the review and modification of lease stipulations that could be applied to future leases and would serve as management objectives.

An SEIS is a document prepared to supplement an EIS when more environmental analysis is needed, generally because of new circumstances or the availability of new information relevant to environmental impacts, or when substantial changes to the original proposed action are being considered. This SEIS will provide additional environmental analysis and will modify the FEIS. However, some portions of the original EIS will not require addition or modification. The FEIS is hereby incorporated by reference and all information included in that document, unless modified or replaced by this SEIS, remains unchanged.

The overall objective for the SEIS is the same as the objective in the FEIS: to facilitate orderly, economic, and environmentally sound exploration and development of oil and gas resources using balanced multiple-use management (FEIS, ROD, page 11). BLM is not proposing changes to the major decisions in the FEIS, namely that: 1) the entire federal mineral estate in the GSRA, except the Wilderness Study Areas (WSAs), would be open for oil and gas leasing and development; 2) BLM would apply lease stipulations and lease notices as appropriate to all new leases; and 3) BLM will develop appropriate Conditions of Approval (COAs) for all Applications for Permit to Drill (APDs) for leases issued prior to the FEIS, provided the COAs are consistent with lease rights granted.

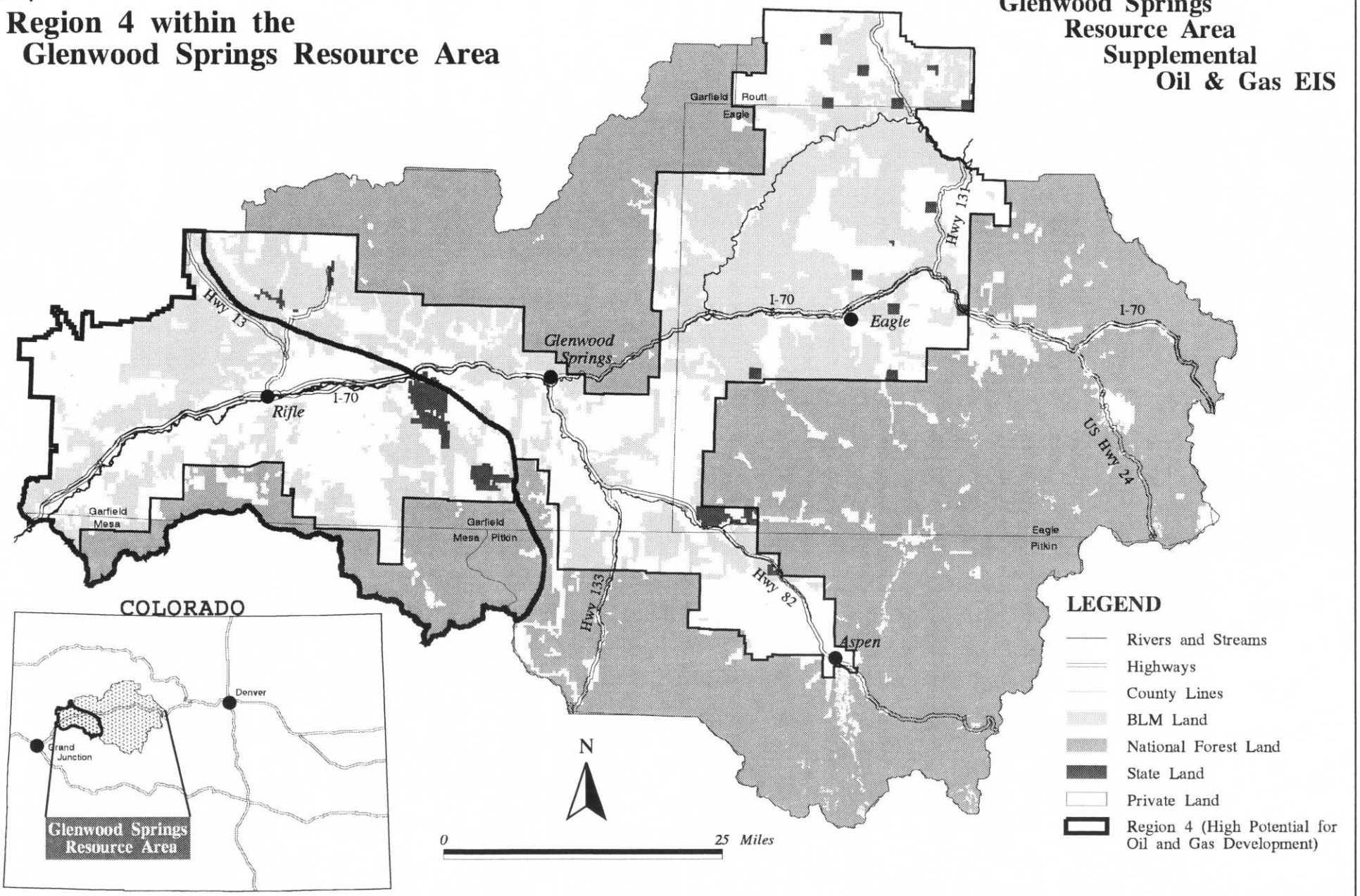
It should be noted that any new or modified stipulations might have little direct legal effect on leases already held. New stipulations cannot be retroactively applied to existing leases. They do, however, express BLM's management objectives in the area. The stipulations also can serve as a guide for voluntary mitigation efforts. Moreover, should any of the current leases expire, new leases would carry the new stipulations.

While the SEIS was being prepared, Congress passed Public Law 105-85, the Department of Defense Authorization Act of 1998 (see Appendix C). Section 3404 called for the transfer of all 56,000 acres of the Naval Oil Shale Reserves (NOSR) near Rifle, Colorado from the Department of Energy (DOE) to the Department of the Interior (DOI) and mandated that the developed portion of the NOSR be offered for lease of its oil and gas reserves within one year of the legislation's enactment. Though the NOSR had not been open to oil and gas leasing, DOE drilled and operates 30 wells and is partners with private oil and gas operators on an additional 28 wells, affecting approximately 7,700 "developed" acres. The purpose of this development was to offset gas production on adjacent property, protecting the U.S. Government's interest in the gas reserves. These lands, referred to as the NOSR Production Area (see Map 1-3), contain roads, wellpads and pipelines and are the portion of the NOSR to be offered for lease. This parcel is immediately adjacent to public lands, is similar in character to those lands and includes many of the same resource values. The purpose of the SEIS is to: 1) comply with the FEIS mandate for a review of environmental effects when the number of wells exceeded the RFD; 2) provide public disclosure of the impacts of a level of development greater than originally anticipated; 3) provide an improved information base for managing gas development impacts; 4) prepare a set of management objectives or standard operating procedures that could be used to

Map 1-1

Region 4 within the Glenwood Springs Resource Area

Glenwood Springs Resource Area Supplemental Oil & Gas EIS



manage future oil and gas development; and 5) permit the review and modification of lease stipulations that could be applied to future leases or used as COAs on existing leases.

Because of its proximity and a physical nature similar to surrounding BLM land, the GSRA decided to include the Production Area in the SEIS. This decision was published in the Federal Register on March 17, 1998.

When the FEIS was prepared, the entire NOSR was included in the analysis area, but was excluded from leasing decisions because the lands were not managed by the BLM. Since the law directs DOI to lease the lands within one year, and since the FEIS did not prescribe leasing stipulations for the area, appropriate management direction and lease stipulations must be developed. The lease stipulations that are developed in this SEIS will apply to the new leases in the NOSR Production Area.

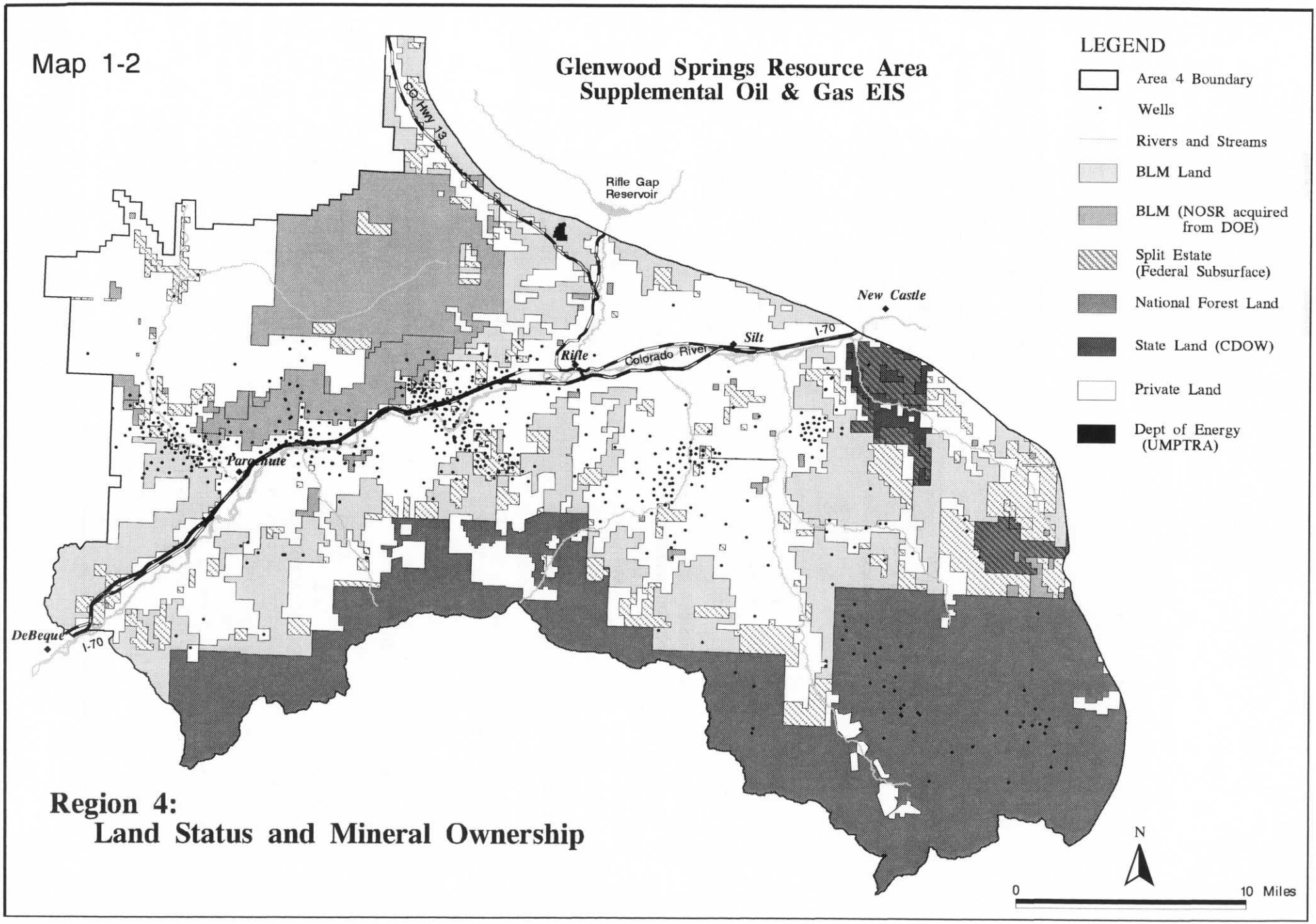
1.3 Location

The FEIS included the entire GSRA (Map 1-1) in its evaluation of impacts (as well as four other Colorado BLM resource areas). This SEIS will also include the entire resource area, but the analysis will focus on the part of the GSRA identified in the FEIS as having a high oil and gas potential (Maps on pages 2-7 through 2-9 in the FEIS). In this document, that area is referred to as Region 4. Virtually all of the gas development activity on BLM lands has occurred in Region 4; since the completion of the FEIS, one well has been drilled outside of Region 4. Future development is expected to follow the same pattern. Within Region 4, the NOSR Production Area (Map 1-3) will be singled out for special reference since it was not explicitly treated in the FEIS and is the area to be offered for lease prior to November 18, 1998.

The area referenced on Map 1-3 as the NOSR Production Area actually contains more acreage than the 7,700 acres that DOE considered economically suitable for gas production. The GSRA decided to include all the lands below the rim of the south aspect of the Roan Cliffs in the SEIS study area, since this land form more closely approximates an entire ecological unit. Additionally, lease boundaries must be delineated in a logical manner that establishes a reasonable lease area with enough potential for profit that the area will actually be of interest to oil and gas operators. It is anticipated that the logical lease boundaries might include some lands outside the currently developed tract. The designated NOSR Production Area is 11,590 acres.

The law transferring the NOSR to DOI directed that the remainder of the 56,000 acre property, that part of the NOSR north of the Production Area, be leased for oil and gas as soon as practicable. The plan amendment and the environmental analysis of leasing decisions for that area will be done in the future. The area will be included here for descriptive purposes and for many acreage calculations, but the SEIS will make no oil and gas leasing decisions for this area of approximately 44,000 acres.

In general, the description of the existing environment and impacts for parts of the GSRA outside of Region 4 are adequately described in the FEIS. Several changes outside Region 4 are of note. Lands acquired by BLM in the GSRA since the FEIS, including King Mountain near Toponas in Routt County in 1992 and the Haff Ranch southeast of Glenwood Springs, are adjacent to and similar in nature to BLM lands covered in the FEIS. They are considered appropriately addressed by the FEIS in regard to the description of the existing environment and the environmental effects of potential oil and gas development.


Map 1-2
Glenwood Springs Resource Area
Supplemental Oil & Gas EIS
LEGEND
Area 4 Boundary
Wells
Rivers and Streams
BLM Land
BLM (NOSR acquired from DOE)
Split Estate (Federal Subsurface)
National Forest Land
State Land (CDOW)
Private Land
Dept of Energy (UMPTRA)
Rifle Gap Reservoir
CO Hwy 13
New Castle
Silt
I-70
Rifle
Colorado River
Parachute
DeBeque
I-70
N
0
10 Miles
Region 4:
Land Status and Mineral Ownership

However, site specific No Surface Occupancy Stipulations, Timing Limitations, Controlled Surface Use Stipulations and Lease Notices will be developed in this SEIS for those newly acquired public lands. In addition, several other areas of public land outside of Region 4 will also be reviewed for the adequacy of the stipulations per the FEIS, because BLM has adopted new management plans for these areas or has imposed management restrictions to achieve specific resource protection goals since the FEIS. In those areas, namely Castle Peak in Eagle County and Glenwood Canyon in Garfield and Eagle Counties, leasing stipulations will be evaluated to ensure the approved stipulations are consistent with the resource protection goals for those areas. Necessary modifications to the impact analysis or mitigation requirements on these lands will be noted in the SEIS.

The GSRA includes 568,000 acres of public land from Edwards to DeBeque and from Aspen to Toponas. Table 1-1 and Map 1-2 describe the distribution of that part of BLM's surface and mineral ownership within Region 4. The BLM surface in Region 4 amounts to 150,377 acres, including the addition of the NOSR. Adding 50,500 acres of split estate brings the total acres of federal oil and gas estate managed by BLM to 200,937, about 35 percent of the total land area in Region 4. Split estate refers to land where the surface is owned by private parties or the State of Colorado, but the mineral estate is the responsibility of BLM.

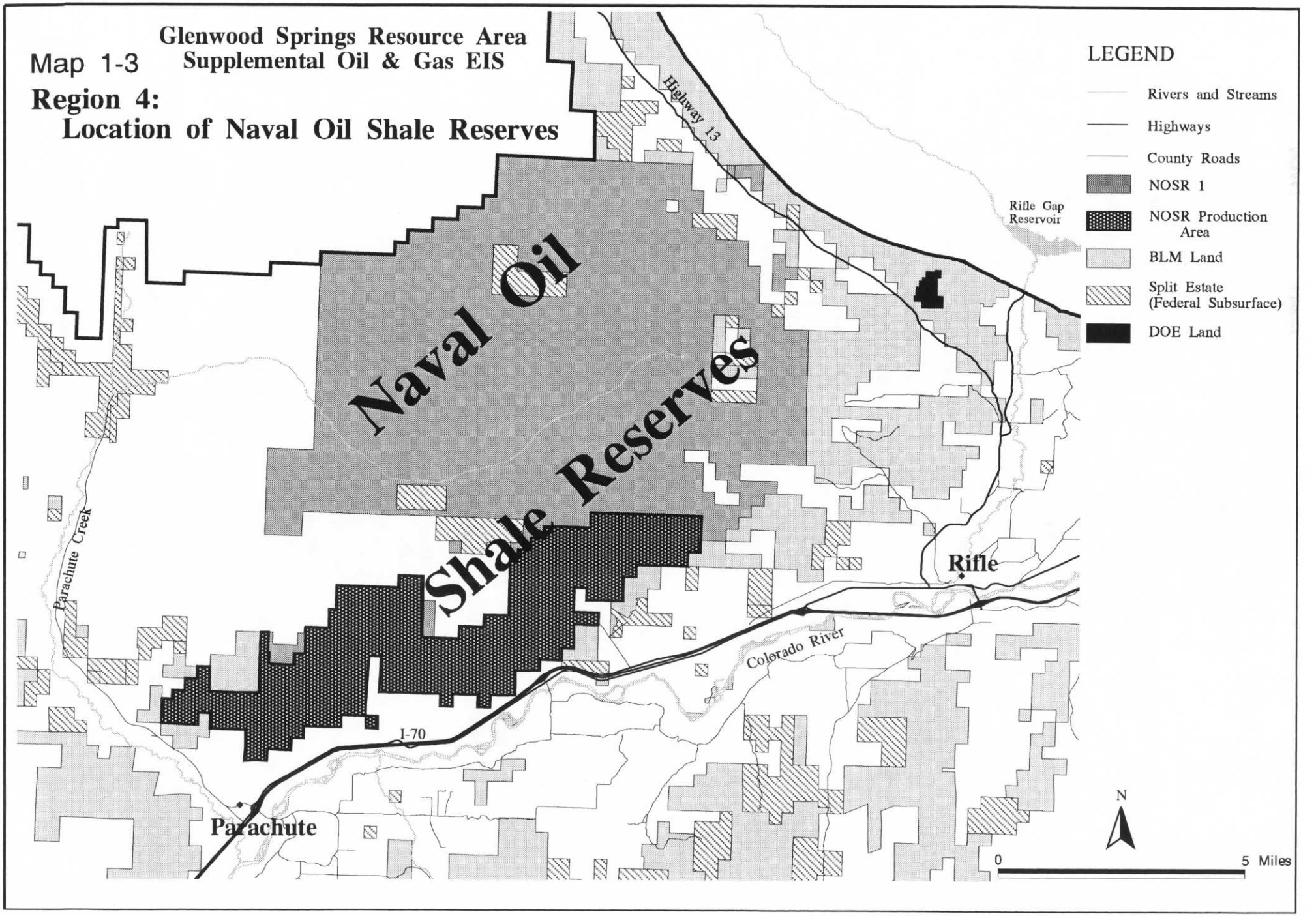
BLM has a role in managing the mineral estate under the 136,418 acres of White River National Forest (WRNF) lands in Region 4, overseeing the leasing of federal mineral estate, and monitoring production from development of those leases. Management of the surface resources on national forest system lands, however, is the responsibility of the United States Forest Service (USFS) and decisions for those lands are not part of this SEIS. The WRNF's Oil and Gas Leasing Final EIS (1993) describes the management of oil and gas development on those lands.

Table 1-1. Mineral Ownership, Region 4

Status	Acres	Percent
BLM	100,545	18
Production Area	11,590	2
Split Estate	50,500	9
REGION 4 STUDY AREA	**162,635**	**29**
NOSR	38,302	7
TOTAL BLM	**200,937**	**35**
National Forest	136,418	24
DOE	205	0
TOTAL FEDERAL	**337,560**	**59.4**
State	3,512	1
Private	227,476	40
GRAND TOTAL	**568,548**	**100**

The remaining 231,193 acres include 205 acres of federal land still managed by the DOE (the Uranium Mill Tailings Remedial Action Project, UMTRAP), 3,512 acres of land owned by the State of Colorado, and 227,476 acres of land on which both the surface and mineral estate are privately held. These last are often referred to as fee lands.

The ownership pattern in Region 4 is substantially broken up, with many small and intermediate-sized tracts of public land intermingled with the private. There are few sizable tracts of unbroken public land in Region 4. This intermingling of ownership has implications for management of oil and gas development and for public perceptions of BLM's role on the management of oil and gas development. Most development on public mineral estate takes place in conjunction with development on adjacent fee land. It is often difficult for the public to distinguish the extent of BLM's management responsibility.


Map 1-3
Glenwood Springs Resource Area
Supplemental Oil & Gas EIS
Region 4:
Location of Naval Oil Shale Reserves
Naval Oil
Shale Reserves
Highway 13
Rifle Gap
Reservoir
Rifle
Parachute Creek
Colorado River
I-70
Parachute
LEGEND
Rivers and Streams
Highways
County Roads
NOSR 1
NOSR Production Area
BLM Land
Split Estate (Federal Subsurface)
DOE Land
N
0
5 Miles

1.4 Relationship to BLM Policies, Plans and Programs

The proposed action and alternatives are consistent with the GSRA RMP, dated January, 1984. The RMP was amended in November 1991 by the Colorado Oil and Gas Leasing and Development Final Environmental Impact Statement (FEIS), which superseded the oil and gas leasing decisions in the RMP. The RMP was amended in March 1997 to incorporate standards for public land health and guidelines for livestock grazing management. The SEIS is consistent with the RMP because it is intended to further the goals of the RMP relative to oil and gas development, namely to facilitate orderly, economic, and environmentally sound exploration and development of oil and gas resources using balanced multiple-use management.

Please refer to Appendix B, Oil and Gas Leasing and Permitting, for specific information about BLM authority and responsibilities for oil and gas operations and a short summary of laws affecting BLM's authority.

1.5 Relationship to non-BLM Policies, Plans and Programs

Leasing decisions for the White River National Forest were made in a USFS planning document, the Oil and Gas Leasing Final EIS (Record of Decision, May 26, 1993). BLM was a cooperating agency in that effort. While this SEIS will discuss the cumulative impacts of oil and gas development on all lands in the study area, the specific impacts of leasing and development of the mineral resource of the White River National Forest will not be analyzed.

BLM is coordinating with the U.S. Fish and Wildlife Service (USFWS) under the terms of the Endangered Species Act. The USFWS has determined that consultation is not required at this time for any listed species other than the endangered Colorado River fishes. BLM has determined the average annual water depletion associated with the development of oil and gas resources in the resource area. Formal consultation was initiated with the USFWS regarding the effect of this depletion on the endangered fish. Please refer to Appendix M for consultation information.

BLM has a memorandum of understanding with the Colorado Oil and Gas Conservation Commission (COGCC) and a long-standing, day-to-day working relationship with the COGCC staff. The working relationship consists of regular communication related to the technical requirements for drilling wells. These include spacing of wells, draining oil and gas reservoirs, and analysis and mitigation of impacts on groundwater. The basis of the relationship is COGCC's authority over oil and gas operations in the State of Colorado.

BLM also works cooperatively with the Garfield County government on issues of mutual concern.

A Memorandum of Understanding, dated December 4, 1978, between Garfield County and the BLM generally describes a mutual agreement to inform and involve each entity in certain planning issues, to appropriate levels.

BLM has a cooperative agreement with the Colorado Division of Wildlife (CDOW) concerning wildlife management. Under this agreement, BLM and CDOW cooperate on actions that affect wildlife habitat and populations. GSRA consultation with CDOW is ongoing and has involved many aspects of this SEIS.

In cases of split estate, BLM leases federal minerals that lie beneath private surface. The private landowner is notified when the minerals

are leased and when an Application for Permit to Drill (APD) is filed. The landowner is invited to attend the on-site inspection and his needs and desires are considered in development of the lease. BLM has the same authority to require mitigation on private surface as it does on federal lands. This ensures the private land owners of protection when the federal minerals are extracted.

1.6 Authorizing Actions

This SEIS does not authorize the construction of any individual well locations. A separate Environmental Assessment (EA) will be prepared in the future for individual APDs. The EAs for APDs are site-specific and include inventories for cultural resources and sensitive plant and animal species. The EA process includes an on-site exam in which BLM and operator and interested stakeholders view the proposed well location in the field to make appropriate adjustments to the location or design of the wellpad and road.

In the future, BLM will be preparing EAs for more Plans of Development (POD) rather than individual APDs. A POD is a more comprehensive proposal for a group of wells along with the associated transportation system. BLM will encourage public participation in the EA process and provide opportunities for concerned citizens, communities and agencies to get involved.

Future EAs would tier to this SEIS and the FEIS as much as possible to avoid duplication of paperwork and make for more efficient APD processing. The EAs would focus on site specific, on-the-ground issues and would not address those larger issues addressed in the EIS documents.

1.7 Scoping Process and Issues

As a result of current and anticipated levels of oil and gas activity in Region 4, BLM, CDOW, landowners, communities and individuals have identified concerns relative to the impacts of oil and gas development activities, especially on wildlife and natural habitats, groundwater, visual resources, transportation systems and residential areas. Public interest in oil and gas issues has increased dramatically as development activities have begun to encroach on residential areas.

The formal scoping process for this SEIS began with a Federal Register notice on April 21, 1997, at which time a statement was released to western Colorado news media. Additionally, an informational package was mailed to about 250 individuals and organizations, most of them residents of the area affected by oil and gas development. The response to this effort was limited. A followup Federal Register notice and press release on March 17, 1998, regarding the inclusion of the NOSR Production Area in the SEIS, generated little response.

During the summer of 1997, an application to the COGCC for higher well density by an oil and gas development company led to considerable public concern. In response to this concern, COGCC sponsored an informational meeting in Battlement Mesa on July 9 in which BLM participated. Over 300 people attended the meeting. This episode generated the most direct response to BLM. Since then, the COGCC and BLM have both engaged the citizens of the area in a number of ways. Two organizations have been consulted a number of times on development issues, the Battlement Mesa Service Association (BMSA) and the Grand Valley Citizen Alliance (GVCA). The BMSA is the oversight body of the unincorporated community of Battlement Mesa; the GVCA is a group formed to address concerns about oil and gas development

throughout Region 4. On February 19, 1998, the COGCC held a forum on its proposed new regulation for incorporating citizen concerns into its spacing decisions, which generated a substantial response.

The following issues have been distilled from the many comments and general interaction described above.

Lease Rights. Most of the high potential gas production area in the GSRA, Region 4, is already held by oil and gas leases which were issued prior to the completion of the FEIS. BLM cannot restrict operations under the lease if such restrictions are not consistent with the lease rights granted. The FEIS states that decisions would be implemented for new operations on existing leases as COAs where those conditions do not adversely affect lease rights already granted.

However, the ability of BLM to require certain COAs on permits is constrained and much of the mitigation approved in the FEIS has been unavailable to BLM, except in situations where the operator would voluntarily agree to such measures. See Appendix B for more information on lease rights.

Reclamation. The success of BLM's efforts to reclaim lands disturbed for gas production has been questioned. Inadequate reclamation may lead to soil erosion, invasion of noxious weeds, loss of wildlife and livestock forage, and visual impacts. Reclamation in arid environments is a very slow process, leading to public perceptions that BLM has required too little of the operator in this regard. See Appendix I for a description of the GSRA policy on reclamation and a review of reclamation to date.

Riparian Community. Riparian zones include some of the most productive and valuable vegetation communities in Region 4; at the same time, topography sometimes dictates that potential well sites and roads be placed directly in or adjacent to these areas. How extensively have riparian zones been affected and how can they be better protected? Sections 3.3.1 and 4.3.1 describe the riparian resource and the impacts on it generated by oil and gas development.

Wildlife. Deer and elk are affected by loss of forage, loss of habitat and disturbance from human activities, especially at critical times. Construction of roads and wellpads removes vegetation used as forage and browse, and alters the structure, and thus the utility, of habitat. The same disturbances and intrusive activities affect other species: raptors, bats, and neotropical birds. Refer to Sections 3.5 and 4.5.

Soils. Any activity that removes surface cover and reshapes the landform may well increase soil erosion. Erosion is even more likely to increase when the disturbance occurs in steep and erosion-prone soils, as is sometimes the case in Region 4. The topography in Region 4 often forces a choice between impacting the riparian zone or an erosive, steep hillside adjacent to the riparian zone. Refer to Sections 3.8 and 4.8.

Visual. The surface disturbance caused by gas drilling alters the natural landform so that the visual character is affected. The production facilities left on the completed well pad also alter the landscape character. Much of the development occurs in the I-70 corridor and hence is visible to many visitors and travelers. Residents of the area often view the disturbance from their homes. Refer to Sections 3.12 and 4.12.

Transportation Systems. Developing natural gas involves a network of roads and pipelines to access the wellpads and transport the gas. The roads affect wildlife detrimentally, create new access for recreation use and alter the visual character of the area. Well drilling rigs and

support equipment travel from site to site and may affect local traffic patterns, damage roads, and create safety issues. In addition to sections on wildlife and visual resources, see Sections 3.17 and 4.17.

Socioeconomic. Gas drilling is an economic activity that brings jobs, creates income and revenue, and requires expenditures for building and maintaining infrastructure. These impacts on local economies are generally considered positive; however, the degree of activity may affect the residential character of the area.

Air Quality. Dust and exhaust from construction and maintenance activities, along with materials discharged from the wellhead in venting and flaring activities, have been identified as possible causes of unacceptable decreases in air quality. These issues are more likely to generate public concern when oil and gas activities encroach on residential areas. Refer to Sections 3.1 and 4.1.

Groundwater. In September, 1997, an underground blowout occurred which resulted in natural gas and drilling fluids migrating into a domestic water well approximately one mile away. The underground blowout was contained by pumping drilling mud and cement to shut off the gas flow. A replacement well for the water showed elevated benzene and methane levels. There are concerns that such problems would develop again on other wells. Refer to Sections 3.9.2 and 4.9.2.

Project Rulison. On September 10, 1969, a 43 kiloton nuclear device (equivalent to 43 thousand tons of dynamite) was detonated six miles southeast of Parachute, Colorado to fracture rock and release gas in a gas-bearing formation 8,426 feet below the surface. The associated wells were plugged and abandoned in September, 1976. Monitoring and testing for radioactive materials has been conducted on a regular basis ever since. In August, 1997, DOE tested five gas wells within three to five miles of the project, and found no indications of radioactive contamination. However, the public is concerned about possible radioactive contamination from Project Rulison and questions whether oil and gas development in the vicinity of the project should be permitted regardless of monitoring and testing results to date. See Appendix J for more information on Project Rulison.

Chapter Two

ALTERNATIVES

2.1 Introduction

Three alternatives were developed to address the issues described in Chapter 1. They include a Continuation of Current Management Alternative, a Maximum Environmental Protection Alternative and a Proposed Action. The regulations of the Council on Environmental Quality at section 1502.14, Title 40, of the Code of Federal Regulations, require that an Environmental Impact Statement (EIS) rigorously explore and objectively evaluate all reasonable alternatives. BLM believes that these three alternatives capture the full range of reasonable management options available to BLM.

The alternatives are defined in terms of the tools available to BLM to manage and mitigate the impacts of oil and gas leasing and development. Those tools are:

- the Standard Terms and Conditions which are attached to every oil and gas lease, in particular lease term Section 6, Conduct of Operations, which is intended to minimize adverse impacts and under which terms an operator's activities can be postponed for up to 60 days or relocated up to 200 meters (see Appendix D for an extended description of standard lease terms
- Lease Stipulations, including No Surface Occupancy (NSO), Timing Limitations (TL) and Controlled Surface Use (CSU) (Appendix B).
- Conditions of Approval (COA) which may be applied at the time of development (Appendix E).
- Lease Notices, which alert lessees to the need for inventories or other special requirements (Appendix B).
- Alternatives considered but not included in the full analysis of environmental impacts are the No Leasing Alternative, a Maximum Production Alternative and a No Action Alternative.

The No Leasing alternative is not considered in this SEIS because the Decision Record for the COGEIS established that all lands except the Wilderness Study Areas (WSA) would be available for oil and gas leasing. In addition, nearly all lands with high potential for oil and gas development (Region 4) have already been leased, except for the NOSR Production Area. BLM considered an alternative that allowed for no leasing of Region 4, but rejected the alternative since the law transferring the management of the NOSR from DOE to BLM makes it clear that the intent of Congress is to make the area available for oil and gas leasing and therefore an alternative to not lease was determined to be directly contrary to the intent of the law.

A Maximum Production alternative might include a reduction in the amount of restraints on development of oil and gas resources and/or special incentives to increase production. Evaluating production incentives was not considered because it is not within BLM's authority to provide such incentives. Reducing restraints on production is within BLM's authority to the minimum provided by the standard lease terms and conditions. The COGEIS is considered to have adequately addressed the Maximum Production alternative since it evaluated a Standard Lease Terms and Conditions alternative. The COGEIS concluded that resource protection provided by the Standard lease Terms and Conditions was not adequate and concluded that additional protective measures were needed.

Reducing the restrictions on oil and gas activities in the NOSR Production Area might increase revenues to the U.S. Government when those lands area leased and might enable a higher rate of natural gas production leading to higher royalties, but the direction of the COGEIS in regards to the appropriateness of the Standard Lease Terms and Conditions alternative clearly suggests that such an alternative would not be appropriate for the NOSR Production Area since those lands are

adjacent and very similar to the BLM lands covered in the COGEIS, contain similar resource values and have similar management issues and conflicts

Since the Maximum Production alternative was considered in the COGEIS, it will not be considered again in this SEIS.

Customarily, an EIS includes a No Action Alternative. In the case of this SEIS, no action would amount to continuing the current management and so the Continuation of Current Management Alternative is considered to accomplish the intent of the No Action alternative. For the NOSR production area, the No Action Alternative is not an option since such an alternative is the same as no leasing and, as described above, would be contrary to the intent of Congress.

2.2 Reasonable Foreseeable Development

The Reasonable Foreseeable Development (RFD) is the level of oil and gas development activity that an objective reviewer might reasonably expect to occur over the next twenty years. The RFD is not a prediction of future activity but rather an assumed level of activity that is used in the analysis of environmental consequences. There are a number of future development scenarios that could be deemed reasonable, depending on the assumptions made with regard to demand for oil and gas, the price of the commodities, technological advances, etc. This section describes the RFD that is used in this analysis and the assumptions that guide it.

Appendix B of the Final Colorado Oil and Gas Leasing and Development EIS (FEIS) discusses the oil and gas potential of the Glenwood Springs Resource Area (GSRA) and the way in which an RFD for the resource area was developed (pages B-1 through B-18). It describes the structural basins in the area, the gas plays and the geologic formations with potential for gas development. In particular, it defines the high potential area of the GSRA as that portion of the resource area within the Piceance Basin (the Tertiary and Upper Cretaceous gas plays). This is the area referred to in this document as Region 4. It also describes the historical and current activity in the GSRA. Based on a trend analysis of historical activity, approximately 300 wells are forecast for the period 1989 through 2010, of which 18 percent, or 54 wells, were expected to be drilled on BLM lands. Of the BLM wells, 36 were expected within Region 4 and 18 were expected on BLM lands outside the play areas. The number expected within Region 4 was subsequently doubled and the FEIS refers to 90 total BLM wells, 72 within Region 4 and 18 in the rest of the GSRA.

The RFD in the FEIS has proven to be low. A total of 72 wells had been authorized by BLM in Region 4 by 1997. At this rate, perhaps 200 wells could be authorized by 2010, the last year of the FEIS analysis period. For this supplemental document, a new RFD that reflects the actual development activity in recent years is required. It will cover a new twenty-year analysis period, 1998 through 2018.

During the last nine years, a period of greatly increased oil and gas activity in Region 4, 457 wells have been drilled, which included 84 wells on BLM-managed mineral estate (18%) and 28 wells on Federal lands administered by the Department of Energy (DOE). In the previous 40 years, a total of only 243 had been drilled, including 46 on BLM-managed mineral estate and 2 on DOE lands (Table 2.2-1).

Table 2.2-1 Wells In Region 4, 1989-97

Year	Wells Drilled			
	Total	BLM	DOE	All Fed.
1989	33	3	8	12
1990	88	9	2	10
1991	15	4	0	4
1992	12	0	4	4
1993	41	13	5	18
1994	81	14	5	19
1995	40	4	4	8
1996	53	10	0	10
1997	94	27	0	27
Total 1989-97	457	84	28	102
Average 1989-97	51	9	3	11
Total 1993-97	309	68	14	82
Average 1993-97	62	14	3	16

A full accounting of gas development activity on BLM-administered mineral estate since 1950 is contained elsewhere in this document. See Section 3.20 for a description of all wells drilled on BLM lands and their current status. Table I-1 in Appendix I includes site disturbance and reclamation information for all BLM wells.

Annual levels of activity have varied, with as many as 94 wells in 1997 and 88 in 1990 and as few as 12 in 1992. Despite the variance, which may be attributed to changes in the wellhead price of natural gas, it seems clear that a relatively high level of activity will be sustained for some time to come. Several possible bases were considered for use in constructing an RFD for this supplemental EIS: a continuation of the average annual activity over the last nine years, a continuation of the average over the last five years, a sustained level at a higher rate than recent experience and a sustained level at a lower rate.

The selected RFD is based on the average activity for the last five years, 62 wells drilled a year. For simplicity's sake, this has been rounded to 60 wells per year. Over the 20 year period of analysis, this would amount to 1,200 additional wells drilled on fee and Federal mineral estate. Activity rates lower and higher than the average were not used because there is no compelling reason to assume that the physical or financial environment will change much in the years to come. No sustained period of higher or lower prices is expected, no potential end to the gas resource is apparent and no major technological innovations are imminent. Therefore, it is assumed that the recent past is our best guide to future developments. The average of the last 5 years was chosen as a basis because this period was thought to more accurately represent the technology and the understanding of the gas resource at work than the nine year average.

During the last five years, wells drilled on BLM-administered mineral estate in region 4 made up about 22 percent of the total. Combining the DOE wells with the BLM wells brings the percentage share to 26 percent. For the RFD, it is assumed that the BLM portion of future development will be 25 percent, or 300 wells over the 20 year period. It is further assumed that 70 of the BLM wells will be located in the Production Area of the Naval Oil Shale Reserves. In the part of the GSRA outside Region 4, this analysis stands with the 18 wells considered in the FEIS.

Several other assumptions were made that affect the analysis of environmental consequences:

- gas development activity would be most intense in those areas that have seen the most activity to date; much future activity will be filling in between already developed sites;
- less dense, but continuous development would radiate out form these areas of concentrated activity;
- market conditions and gas prices were assumed to have cyclic ups and downs which would average out over the 20 year period.

2.3 Mitigative Measures Common to All Alternatives

Appendix E gives a thorough description of the Stipulations, Conditions of Approval (COAs) and other forms of mitigation that are common to all alternatives.

2.4 Alternatives

2.4.1 Continuation of Current Management Alternative

The FEIS considered three alternatives, the Standard Terms and Conditions Alternative (standard lease terms and conditions only with no additional stipulations of any kind), the Continuation of Present Management Alternative (standard lease terms and conditions, with NSOs for some specific areas, and seasonal restrictions to protect wildlife), and the Proposed Action Alternative (leasing with standard terms and conditions, NSOs for specific areas, seasonal restrictions to protect wildlife and a series of additional stipulations necessary for resource protection). Refer to Chapter 2 of the FEIS and Appendices E and F of this document for more details.

The Continuation of Current Management Alternative in this SEIS is the same as the Proposed Action in the FEIS and recorded in the Record of Decision (November, 1991). It includes 27,280 acres of no leasing in four WSAs, about 175,000 acres of No Surface Occupancy for the protection of wildlife, watershed and recreation values, a group of Timing Limitations (TL) for the protection of wildlife, and Controlled Surface Use (CSU) designations for the protection of coal mines, riparian, watershed and Visual Resource Management (VRM) values.

Because most of the BLM land and federal mineral estate in this area was leased before the current leasing decisions had been made, application of individual stipulations depends on the voluntary compliance of the gas development operators. In some cases, that compliance has been forthcoming. In this situation, analysis of impacts is complicated in that it must be assumed that leases contain only the standard lease terms and conditions but the existence of the stipulations may still exert some effect. For the NOSR Production Area, this alternative will assume that the stipulations from the FEIS as well as the Standard Terms and Conditions apply.

2.4.2 Maximum Protection Alternative

This alternative includes all the elements of the Continuation of Current Management Alternative and additional provisions aimed at maximizing the protection of surface resources and minimizing adverse environmental impacts, regardless of the effect on gas production. The alternative adds more stringent restraints on operations in riparian areas, protects wildlife seclusion areas, provides stricter control of surface disturbing activities when slopes exceed 25 percent, and extends and more closely defines protection of the visual resource. See Appendix F for a more complete description of the alternative.

Like the Continuation of Current Management Alternative, the provisions of this alternative cannot legally be applied to existing leases and for that reason, compliance in most of Region 4 would be voluntary. They could however, be applied to the rest of the GSRA and to the new leases in the NOSR Production Area.

2.4.3 Proposed Action

The Proposed Action was selected to accomplish the following objectives:

- Provide a reasonable balance between surface resources and subsurface values;

- Be consistent with Federal and State laws and policies;
- Consider the long-term as well as the short-term and not preclude options for the future;
- Be understood by all stakeholders;
- Acknowledge public concerns;
- Establish BLM's preferred management objectives and best management practices, even if current lease rights might preclude such options;
- Acknowledge BLM's multiple use mandate;
- Support BLM's Land Health Standards.

Achieving the Colorado BLM Standards for Public Land Health was an explicit requirement of all elements of the Proposed Action. Those standards are:

1) *Upland soils* exhibit infiltration and permeability rates that are appropriate to soil type, climate, land form, and geologic processes.

2) *Riparian systems*, associated with both running and standing water, function properly and have the ability to recover from major disturbance such as fire, severe grazing, or 100-year floods.

3) Healthy, productive *plant and animal communities* of native and other desirable species are maintained at viable population levels commensurate with the species' and habitat's potential.

4) *Special status, threatened and endangered species,* and other plants and animals officially designated by the BLM, and their habitats are maintained or enhanced by sustaining healthy, native plant and animal communities.

5) The *water quality* of all water bodies, including groundwater where applicable, located on or influenced by BLM lands will achieve or exceed the Water Quality Standards established by the State of Colorado.

Additionally, the Proposed Action is based on the concept of establishing management objectives and standard operating procedures, independent of lease rights already granted. Lease rights would be considered at the time such practices or standards are actually applied on-the-ground to site specific applications to drill. It is recognized that many of these objectives may be inconsistent with certain lease rights already granted and therefore would have to be modified or waived on a case-by case basis.

The Proposed Action is BLM's preferred alternative. It is hoped that the Proposed Action represents a set of management goals and desired outcomes such that BLM, the leaseholders and other stakeholders could discuss development proposals and seek to accomplish the intent of the Proposed Action whenever possible.

2.4.4 Comparison of Alternatives

This section describes the major differences between each alternative in the context of the major scoping issues identified in Chapter 1.

Lease Rights. All alternatives, regardless of the level of restriction placed on oil and gas development activities, must be consistent with lease rights. About 95 percent of Region 4 is already leased subject to Standard Lease Terms and Conditions only. Portions of any alternative determined to be inconsistent with lease rights could not be implemented except on a voluntary basis. The Maximum Protection Alternative places the most restrictions and the Continuation of Current Management Alternative places the fewest restrictions on oil and gas activities. Thus, the Maximum Protection Alternative is more likely to be inconsistent with lease rights and old leases than the Continuation of Current Management Alternative.

Reclamation and Soils. The three alternatives limit or control development activities on steep slopes and erosive soils to varying degrees in order to increase the likelihood of successful reclamation. The Continuation of Current Management Alternative establishes performances objectives and standards with a Controlled Surface Use (CSU) stipulation on

fragile soils and on slopes greater than 40 percent. The Maximum Protection Alternative establishes No Surface Occupancy (NSO) stipulations on highly erosive soils and on slopes greater than 25 percent to maintain standards for pad size and cut and fill slopes. The Proposed Action establishes an NSO on slopes greater than 35 percent, uses a CSU to protect highly erosive soils and maintain standards for pad size and cut and fill slopes on slopes greater than 25 percent. The GSRA Reclamation Policy applies to all three alternatives.

Riparian Community. The Continuation of Current Management Alternative uses an NSO to restrict oil and gas development in the riparian vegetation zone. The Maximum Protection Alternative establishes an NSO (with exceptions) for an area 500 feet beyond the outer edge of the riparian zone. The Proposed Action uses an NSO to protect the actual riparian vegetation and establishes a CSU on an area 500 feet either side of the edge of the riparian vegetation.

Wildlife. The Maximum Protection Alternative and Proposed Action establish wildlife seclusion areas, protected with an NSO. The Continuation of Current Management Alternative does not address seclusion areas. The Maximum Protection Alternative also establishes an NSO for waterfowl habitat and an additional Timing Limitation (TL) for sage grouse nesting habitat. Through the use of COAs, the Maximum Protection Alternative would require well monitoring via remote sensing, restrict travel during certain times of the day and require habitat improvement projects in critical habitat areas. The Proposed Action establishes an additional TL for sage grouse nesting habitat. Through COAs, the Proposed Action encourages the operator to work with CDOW on "working in wildlife habitat" issues and requires the operator to develop and implement specific measures to reduce impacts on wildlife and wildlife habitats through the well permitting process.

Visual. The Continuation of Current Management Alternative provides a CSU to protect Class II Visual Resource Management (VRM)areas. The Maximum Protection Alternative establishes an NSO on certain slopes over 25 percent in several viewsheds and protects the Roan Cliffs area with an NSO. A CSU on slopes less than 25 percent is used to provide additional protection to the Class II portions of the Interstate 70 viewshed. The Proposed Action provides an NSO to protect slopes 25 percent or greater in the Interstate 70 viewshed and protects the Roan Cliffs area. A CSU protects portions of other viewsheds in Region 4, but no relocation of operations more than 200 meters is included.

Socioeconomic. The alternatives provide for a range of restrictions on oil and gas development activities that would somewhat affect the total number of wells drilled on public lands which affects the amount of Federal royalties. The Maximum Protection Alternative and the Proposed Action each establish a "working in residential areas" COA to require the operator to reasonably address issues in residential areas. The Maximum Protection Alternative provides a 1/4 mile buffer around residences. Both the Proposed Action and Maximum Protection Alternative require the operator to prepare an Emergency Communications Plan.

Air Quality. All three alternatives provide for oil and gas development operations consistent with State and Federal air quality standards. The Maximum Protection Alternative requires the operator to participate in air quality monitoring if necessary.

Project Rulison. The Maximum Protection Alternative establishes a no leasing zone within one mile of Project Rulison. Both the Maximum Protection Alternative and the Proposed Action require that all wells within three miles of Project Rulison be subject to oversight measures established by the COGCC.

Groundwater. All three alternatives provide for oil and gas operations to protect useable groundwater. The Maximum Protection Alternative provides for the operator to participate

in groundwater monitoring if necessary and establishes a CSU to require the operator to prepare a groundwater risk assessment for wells in the overpressure zone.

Chapter Three

AFFECTED ENVIRONMENT

3.1 Introduction

Chapter 3 of the Colorado Oil and Gas FEIS described the affected environment of the Glenwood Springs Resource Area (GSRA). Those portions of that original affected environment description that remain accurate and sufficient are not repeated here. Those portions that require modification or more extensive information are included in this chapter. If the resource description in this document replaces, modifies or supplements the description in the original FEIS, it is so noted. If no change is needed, the reader is referred to the FEIS.

As discussed in Chapter 1, the focus of this supplemental EIS is on Region 4 of the GSRA, the area of highest potential for oil and gas development. Within Region 4, the Production Area of the recently acquired NOSR receives additional attention, as it was not included in the original EIS. That part of the NOSR north of the Production Area is not formally included in the analysis, but is included in the affected environment discussion. The remainder of the GSRA will be referenced occasionally as needed.

3.2 Climate & Air Quality

Climate. Region 4, the focus of the Glenwood Springs Resource Area Supplemental Oil and Gas EIS, lies along the Colorado River drainage between the communities of New Castle and DeBeque, Colorado, from east to west, and between the mountainous White River and Grand Mesa National Forests on the north and south. Because of the wide variations in elevation and topography within the area, climatic conditions vary considerably. Along the Colorado River drainage, average daily temperatures typically range between 12 (low) and 40 (high) degrees Fahrenheit in mid winter and between 50 (low) and 95 (high) degrees Fahrenheit in mid-summer. The frost-free period (at 32 degrees) generally occurs for 170 days between mid-April and mid-October. The annual average total precipitation is nearly twelve inches, with 30 to 40 inches of annual snowfall. Temperatures will generally be cooler, frost-free periods shorter, and both precipitation and snowfall greater at the higher elevations north and south of the Colorado River drainage.

Wind conditions will reflect channeling and mountain valley flows due to complex terrain. Nighttime cooling will enhance stable air, inhibiting air pollutant mixing and transport along the Colorado River drainage. Dispersion potential will improve farther east and west, and along the ridge and mountain tops, especially during winter-spring weather transition periods and summertime convective heating periods.

Air Quality. Although specific monitoring is not conducted throughout most of Region 4, air quality conditions are likely to be very good. Air pollution emission sources are limited to a few industrial facilities, transportation emissions along the I-70 corridor and residential emissions in the relatively small communities. Based on data provided by the Colorado Department of Public Health and Environment, Air Pollution Control Division (CDPHE-APCD; Chick 1998), particulate matter less than 10 microns in effective diameter (PM_{10}) concentrations measured at Rifle (32 æg/m^3 annual and 72 æg/m^3 second 24-hour maximum) are well below the Colorado and National Ambient Air Quality Standards of 50 æg/m^3 annual and 150 æg/m^3 24-hour. Rural values are likely to be considerably lower. Similarly, gaseous pollutant concentrations at Rifle are assumed to be well below applicable air quality standards (carbon monoxide: 10 ppm second 1-hour maximum, 6 ppm second 8-hour maximum; nitrogen dioxide: 0.002 ppm annual; ozone: 0.088 ppm annual; and sulfur dioxide:

0.012 ppm second 3-hour maximum, 0.006 ppm second 24-hour maximum, 0.002 ppm annual).

Two Prevention of Significant Deterioration (PSD) Class I Areas are downwind of the project area, the Flat Tops and Maroon Bells-Snowmass Wilderness Areas, administered by the U.S. Forest Service. Limitations on the additional amount of air pollution allowed in these areas from major emitting facilities are strict. The remainder of this central western Colorado region is classified as PSD Class II, including the Raggeds Wilderness Area, where similar but less stringent incremental pollution limits apply.

3.3 Vegetation

The relative percentages of the different vegetative types which occur in the GSRA and their wildlife values were discussed in the 1991 FEIS (p. 3-7). This information is still valid except where it has been modified by discussions in this SEIS. The value of each vegetation type is more thoroughly explained in Section 3.5, Wildlife. The description of riparian vegetation is discussed below in 3.3.1. Updated information on Special Status Species and significant natural plant communities (referred to as Remnant Vegetation Associations in the FEIS) can be found in Section 3.6.

The geographic position of the resource area has created a high diversity of vegetation types. Using the National Hierarchical Framework of Ecological Units, the GSRA straddles the boundary of three ecological units, the Uinta Basin Section, the Tavaputs Plateau Section and the North-Central Highlands/Rocky Mountain Section.

The Uinta Basin and Tavaputs Plateau describe the area north of I-70 and west of the Grand Hogback. The rest of the Resource Area, south of I-70 and east of the Hogback, is contained within the North-Central Highlands/Rocky Mountain Section. The Uinta Basin contains gently rolling slopes and foothills west of the Grand Hogback. The climate is arid and vegetation is predominantly pinyon-juniper woodlands and salt desert scrub.

The Tavaputs Plateau describes the Roan Cliffs area west of Rifle. This ecological type is relatively rugged. It slopes gradually southward and upward until it is abruptly cut off to form a series of linear cliffs. The high plateaus have steep walled canyons. Vegetation in the Tavaputs Plateau Ecological Unit is characterized by mixed mountain shrub, mountain grasslands, aspen, Douglas-fir and spruce-fir.

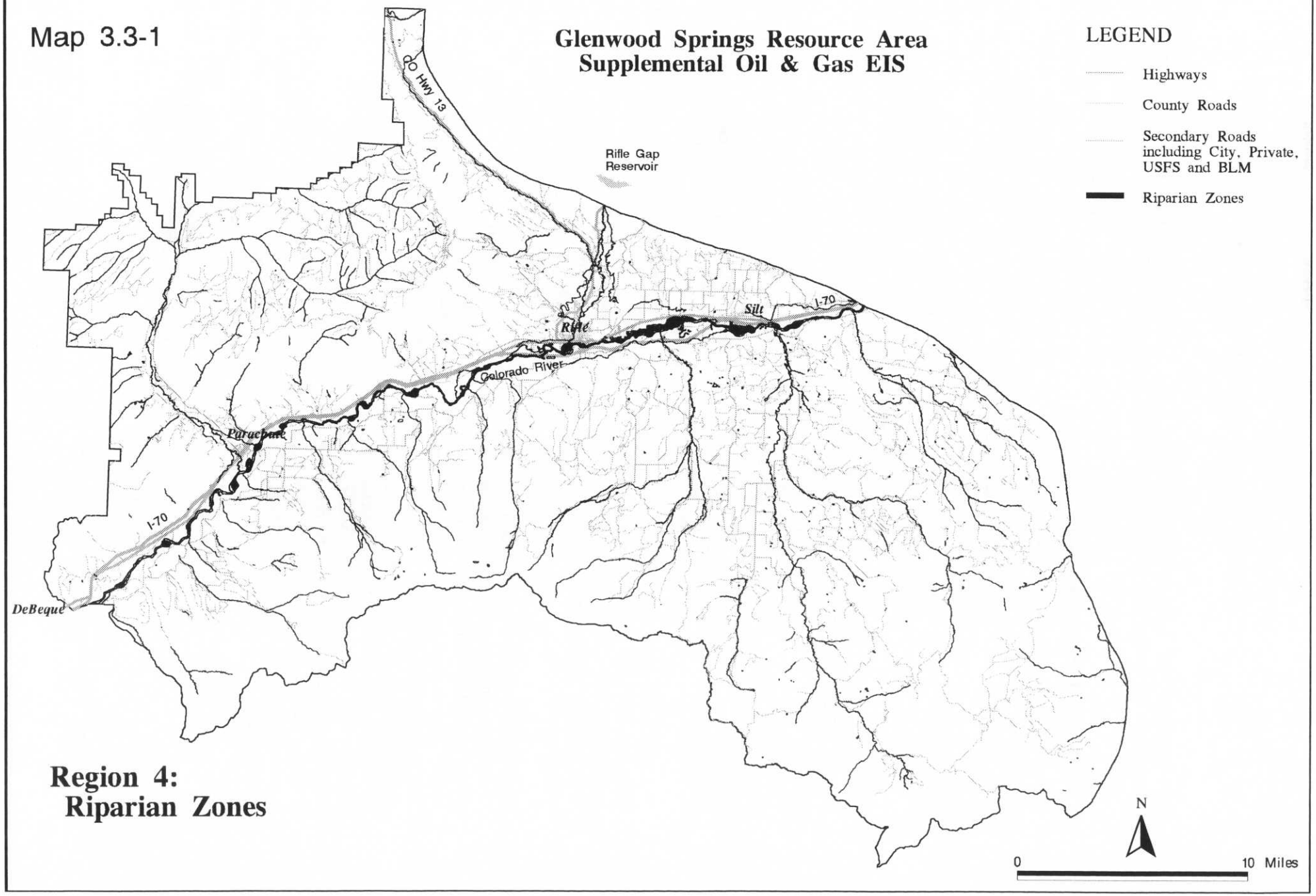
The third ecological unit is the North-Central Highlands/Rocky Mountain unit. This area generally includes steeply sloping to precipitous flat-topped mountains and mesas dissected by narrow stream valleys with steep gradients. Vegetation found in this unit is a mix of sagebrush steppe, pinyon-juniper woodlands, oakbrush/ mixed mountain shrub, aspen, spruce-fir, Douglas-fir and meadows of grass and sedge.

3.3.1 Riparian and Wetlands

Riparian areas are the strips of land which border streams, rivers, springs, lakes, or other bodies of water. These areas are strongly influenced by water and consist of distinctive vegetative communities. Most of the riparian areas in Region 4, other than the Colorado River, are relatively narrow. The arid climate and the steep terrain limit the water-influence zone. Of the 568,548 acres of land within Region 4, there are roughly 3,525 acres of riparian vegetation, which is only 0.6 percent of the total acreage (Table 3.3.1-1). Although riparian areas typically comprise less than one

Map 3.3-1

Glenwood Springs Resource Area
Supplemental Oil & Gas EIS



Region 4: Riparian Zones

percent of the area in the arid western United States, they are among the most productive and valuable of all lands.

Table 3.3.1-1 Riparian Acreage, Region 4

Status	Surface Acreage	Riparian Acreage
BLM	100,545	182
Production Area	11,590	10
Split Estate	50,500	113
STUDY AREA	**162,635**	**305**
NOSR	38,302	126
TOTAL BLM	**200,937**	**431**
National Forest	136,418	196
DOE	205	0
TOTAL FEDERAL	**337,560**	**627**
State	3,512	31
Private	227,476	2,867
REGION 4 TOTAL	**568,548**	**3,525**

Wetlands are a subset of riparian areas and are defined as areas that contain hydrophytic plants, hydric soils, and surface or subsurface water. This generally includes swamps, marshes, and wet meadows.

Riparian and wetland areas are important for the presence of water, and the variety and structure of the vegetative community. Riparian areas usually have a greater diversity of vegetation than the surrounding uplands. In Region 4, the adjacent uplands are often devoid of trees or have only a thin stand of trees. Therefore, the riparian area with its greater variety and structure of vegetation provides nesting cover, forage, hiding cover, and corridors for movement which are often limited outside of the riparian area.

Riparian and wetland areas provide forage for domestic animals and essential food, water, cover, and nesting habitat for approximately 75 percent of our wildlife species. Over 80 percent of Colorado breeding birds are dependent on riparian areas (Knopf 1985). Where streams are perennial, they provide essential habitat for fish and other aquatic organisms. Healthy riparian systems are also recognized for filtering out sediments, contributing to groundwater recharge, extending seasonal stream flows and improving the quality of water yielded from watersheds, creating a protective shield against the erosive force of water, as well as providing recreational and scenic values.

BLM's Riparian-Wetland Initiative for the 1990's established national goals and objectives for managing riparian-wetland resources on public lands. One of the chief goals of this initiative was to maintain or restore riparian-wetland systems so that 75 percent or more were in proper functioning condition by 1997. GSRA recently completed a Functioning Condition Assessment of perennial streams in the Resource Area. The assessment rated 67 percent of GSRA streams in Proper Functioning Condition (PFC), 30 percent as Functional-at-Risk (FAR) and seven percent as Non-Functional (NOT). The results of the assessment indicate that GSRA has not yet achieved the national goal but continues to make progress toward that end. Within Region 4, 33 streams (41 miles) are in PFC, 25 streams (36 miles) are FAR, and 10 streams (11 miles) are considered Non-functioning.

Before authorizing any activity on BLM-managed lands, BLM must consider the potential effects of those actions on stream function. The stipulations and mitigation measures described herein are designed to maintain or restore proper functioning condition of riparian systems.

Although BLM managed land comprises 35.3 percent of the total land base in Region 4, BLM manages the surface or mineral estate on only 431 acres or 12.2 percent of the total riparian areas. Early homesteaders preferred to settle along streams and valley bottoms where irrigable and ranchable lands were found. The public lands that remained after homesteading were mostly the steep, dry hills, with few streams or riparian areas.

The principal riparian resources in Region 4 are the Colorado River and the larger tributaries which include: Garfield, Divide, Beaver, and Parachute Creeks. Most of this riparian habitat occurs on private land. The primary riparian habitat on BLM managed land includes Riley Gulch, Dry Creek, Cottonwood Gulch, Wallace Creek, East Fork and East Middle Fork Parachute Creek, and Baldy Creek. Of these, Riley Gulch, Cottonwood Gulch, and Baldy Creek have already been affected by roads along all or a portion of their lengths. East Fork and East Middle Fork of Parachute Creek are by far the most extensive BLM riparian areas in Region 4 and are also the largest remaining unaffected areas. Each of these areas is composed of a late-seral riparian vegetative community consisting largely of mature cottonwoods, willows and various herbaceous species.

3.4 Livestock Grazing

The Livestock Grazing portion of the Affected Environment was discussed on page 3-10 of the FEIS. A preliminary evaluation of the impacts of oil and gas development on livestock grazing since the publication of the FEIS indicated that no additional discussion was necessary.

3.5 Wildlife

3.5.1 Introduction

The major upland habitats and wildlife species present are discussed on pages 3-7, 3-11 and 3-12, of the FEIS. A detailed discussion of the environment of Game Management Unit (GMU) 32 is included in the "GMU 32 Wildlife Habitat Analysis" (Broderick and Coleman, 1995), available in the GSRA office. A similar but more cursory mapping effort was also completed for GMU 42. That work is still being refined. Narrative descriptions of the GMUs are included in Appendix G.

The CDOW has mapped seasonal use areas for many species of wildlife in Colorado. This data is stored in the "Wildlife Resource Information System" (WRIS) in a Geographical Information System (GIS) and was used extensively to derive the following information for wildlife in the SEIS. Habitats referred to in the text of this document include: winter range, winter concentration areas, severe winter range, summer range, production areas, critical habitat, seclusion areas and fall concentration areas (see Chapter 7, Glossary). Critical Habitat as defined by the CDOW, will hereafter be referred to as crucial habitat, to avoid conflict with the legal term Critical Habitat as defined by the US Fish and Wildlife Service in regard to Threatened and Endangered Species.

This SEIS addresses gas development throughout the GSRA; however, most of the discussion focuses on Region 4. The FEIS addressed, in a general sense, most of the habitat types and species in the GSRA, thus, this discussion will focus on those wildlife management species of concern that occur in Region 4 and are expected to be affected more than minimally.

3.5.2 Regional Overview

The natural environment in Region 4, especially at the lower elevations, has been radically altered over the past 30 years by development. Interstate 70 was constructed in the 1970's and bisects the Colorado River valley, effectively eliminating big game herd migration across the valley in many areas, thus forcing them to concentrate in less desirable habitat and increasing road kill mortality. Oil shale development and the associated infrastructure during the late 1970's and early 1980's eliminated thousands of acres of summer and winter range.

Gas development began to pick up pace in the early to mid-1980's and has directly impacted approximately 1,800 acres to date, but with the associated roads and traffic, has indirectly impacted over 10,000 acres. Subdivision development, associated infrastructure and recreational demands, such as increased use of off-highway vehicles, have affected even more wildlife habitat. As a result of this development activity, the importance of those habitats not yet impacted has increased.

Fire suppression over time has allowed many vegetation communities to move into late-seral condition, resulting in over-mature and decadent stands of vegetation. Noxious weeds are also becoming a greater problem throughout the area. They replace desirable forage and cover plants and contribute to the loss of valuable wildlife habitat.

Game Management Unit Descriptions. The "GMU 32 Wildlife Habitat Analysis" provides site specific mapping of important wildlife habitat values in GMU 32. A similar but not as detailed analysis has been completed for GMU 42. The GMUs were mapped using four criteria: *High Value Habitat, Moderate Value Habitat, Lesser Value Habitat* and *Seclusion Areas*. The seclusion areas fall within and may extend across boundaries of the various habitat areas. These labels are defined in the Glossary (Chapter 7) and the Habitat Areas are mapped in Appendix G.

Seclusion areas typically are relatively small habitat areas in comparison to the overall habitat. They possess unique qualities (optimum mix of quality forage, cover, and water, proximity to natural migration corridors, and presence of topographic and habitat features which moderate severe winter conditions in winter range, provide birthing areas and important summer habitat at high elevations, and/or provide security from human intrusion) and thus support higher densities and a greater diversity of wildlife species. Along with riparian areas, seclusion areas are, acre for acre, the most valuable habitat.

Region 4 includes portions of nine GMUs: 22, 23, 31, 32, 33, 42, 421, 43 and 521. The majority of public lands managed by the BLM in Region 4 occur in GMUs 31, 32, 33 and 42; however, most of the discussion will focus on GMUs 32 (north of the Colorado River) and 42 (south of the river) since most of the gas development activity in the next 20 years is expected to occur in these GMUs. The CDOW manages big game species by herd units defined as Data Analysis Units (DAUs). These DAUs are composed of one or more Game Management Units (GMUs).

GMU 32 consists of high plateaus dissected by canyon country and dominated by the Parachute Creek drainage. Steep, exposed shale cliffs (the Roan Cliffs) separate the plateau from the lower side slopes which are characterized by dense mixed mountain shrub with pockets of Douglas fir on the north aspects, and by steep and barren to very sparsely vegetated land with low growing shrubs, forbs and some grasses. Pinyon-juniper woodlands and mountain shrub dominate the mid- elevations, with sagebrush, saltbush and greasewood in the lowlands. The

top of the plateau consists of rolling terrain dissected by numerous streams. Vegetation consists of a diverse mixture of mountain sagebrush, mixed mountain shrub, aspen, and spruce-fir stands. The general aspect is southerly with elevations ranging from 4,500 feet to over 9,000 feet. The most dominant feature of GMU 32 is the Roan Cliffs which extend from Rifle, Colorado, west to Parachute Creek and up the Parachute Creek drainage for many miles.

The NOSR Production Area is included in GMU 32 and lies east of Parachute, between the top of the Roan Cliffs and the Colorado River Valley. The Roan Cliffs support a high population of nesting raptors, including the Federally Endangered peregrine falcon. They are also thought to support at least one important bald eagle roost. Cottonwood Creek is the only significant stream occurring within the production area and it supports an important riparian area. The Roan Cliffs were mapped as a high value area and seclusion area because of its importance to nesting raptors. The Cottonwood Creek area was also mapped as a High Value Area with the upper portion being mapped as a seclusion area because of its important wildlife habitat values, including a bald eagle roost area. Most of the rest of the production area was mapped as moderate or low value because of the lower habitat quality (steep, barren slopes or desert scrub dominated by cheatgrass and other weedy species), limited free water, heavy development from the gas industry along the lower fringe and poor big game access due to Interstate 70 and lack of passage through the Roan Cliffs.

Seclusion areas in GMU 32 are relatively roadless portions of the upper reaches of the canyons, which provide an important solitude component. These canyons are typically bisected by live streams supporting a mature riparian zone. Mesic areas located on the slopes are not uncommon. The southerly and westerly aspects are typically mixed mountain shrub while the easterly and northerly aspects support conifer and aspen stands. The vegetative diversity of these areas provides excellent habitat for many wildlife species including raptors, small mammals, amphibians, reptiles, migratory passerine birds, turkey, blue grouse, chukar and big game.

Mountain lion, bobcat and black bear are likely to be found and the potential exists for bald eagle roosts and Mexican spotted owl. The southern aspects of these areas are critical as winter foraging areas for deer and elk, especially during heavy snow years. The areas also provide transition range important to mule deer and many of these areas provide migratory corridors from the valley floor through the Roan Cliffs, to the Roan Plateau which serves as summer range for all the big game species. The seclusion areas vary in size from Cottonwood Gulch with 610 acres to Magpie Gulch with 5,097 acres. The percent of public land also varies from 10 percent in Riley/Starkey Gulches to 95 percent in Magpie Gulch. The seclusion areas with a low percentage of public land generally occur in the lower reaches of drainages where public land may influence the use of private land farther up the drainage. Appendix G provides a more detailed description of each seclusion area.

GMU 42 is mountainous, extending to the divide between the Colorado River and Plateau Creek. The northern portion consists of flatter ranch land. The Battlement Range is the dominant feature along the central portion of the unit. Vegetation varies from low elevation sagebrush, farm fields and pinyon-juniper stands, grading up into mixed mountain shrub, aspen and spruce-fir forests at the upper elevations. The dominant aspect is northerly. The elevation ranges from 3,000 feet to over 10,000 feet.

Seclusion areas in GMU 42 are typically located on relatively steep, rugged terrain. Two of them are mostly in the Garfield Creek State Wildlife Area. Other areas are found in Paradise Creek, Jackson Gulch Coal Ridge, and the fringe area along the north flank of Battlement Mesa. The diversity of habitat and the wildlife species using these areas is generally greater than other areas, they are typically dissected by riparian areas and often provide an important component of a species life cycle, such as a production area, winter concentration area of crucial habitat of some type. These areas include either winter range or summer range for mule deer and elk.

Habitat Type Descriptions. Major habitat types in the Region include:

Semi-desert scrub (saltbush, sagebrush, winterfat and greasewood): This type is generally limited to the drainage bottoms from Rifle west to the GSRA boundary. This area is typically dry with relatively low forage production and low winter snowfall. It is found at the lowest elevations in the GSRA on relatively flat terrain and is usually the area most available for mule deer forage during severe winters. These areas are defined as severe winter range and crucial habitat for mule deer and elk. Little cover is provided except for small mammals and birds. Several sensitive species are associated with this habitat (see Table 3.6-1).

Juniper woodlands (juniper and pinyon with an understory of serviceberry, mountain mahogany and Mormon tea): This is the most extensive type found in the GSRA. It generally occurs on the southern slopes of the lower foothills just above the semi-desert scrub and is often interspersed with the semi-desert scrub and low elevation sagebrush type. The juniper woodland habitat provides important food and cover for wintering mule deer and elk, food and cover for a variety of small mammals and birds and is usually defined as severe winter range and crucial habitat for mule deer and elk. Several raptor species nest in the Juniper woodlands. These areas are generally arid with limited understory production unless tree canopy is fairly open.

Low elevation Sagebrush: This type also occurs at the lower elevations, is usually arid and, in the GSRA, the understory is limited. This area is very important to wintering mule deer and to a lesser degree, to wintering elk. During severe winters, mule deer diet is composed of browse species, with sagebrush the main component. It is usually defined as severe winter range and crucial habitat for mule deer and elk. Little cover is provided except for small mammals and birds. Several sensitive species are associated with this habitat see Table 3.6.1).

Mixed mountain shrub (oakbrush, serviceberry, chokecherry, snowberry, mountain mahogany, sagebrush): This type occurs at the mid elevations and usually has a well developed understory of grasses, forbs, and sedges. Springs and mesic areas are not uncommon. This type is generally mapped as mule deer winter range and may be mapped as elk severe winter range and crucial habitat. Aspect varies but is usually northerly and occurs on moderate to steep slopes. The mixed mountain shrub type provides some nesting habitat for raptors and is very important in some areas to black bear and turkey. It is often used as fawning and calving habitat for big game.

Conifer (Douglas fir, subalpine fir, Englemann's spruce, lodgepole pine): This type is located at higher elevations, typically above 8,000 feet, and/or on northern aspects. Understory usually consists of low growing shrubs and the areas are relatively dry except for heavy winter snowpack. These areas provide important thermal and hiding cover for a variety of species and roosting and nesting habitat for a greater variety of raptors. This is usually considered summer range for big game.

Aspen (aspen, chokecherry, snowberry): This type is also located at higher elevations, typically above 8,000 feet, and/or on northern aspects. These areas are usually mesic and support a very diverse understory of grass, forbs and shrubs. They are preferred as calving areas, provide important habitat for bear during the spring months and provide nesting habitat for a large variety of raptors. These areas provide important summer food and thermal and hiding cover for big game.

Riparian/wetland/mesic (cottonwood, willow, redosier dogwood, alder, sedges, rushes, cattail): Riparian, mesic and wetland are especially important to a large variety of wildlife since they provide all the essential habitat elements and often provide the primary cover in the more desert types of habitat as well as needed water. The vegetative diversity and water associated with this habitat type supports the greatest abundance of species and numbers of wildlife and yet it comprises less than two percent of the overall habitat in Colorado, and less than one percent of the habitat in the GSRA. It provides important nesting habitat for a variety of neotropical migratory bird species, raptors, Merriam's turkey, and fawning and calving habitat.

One facet of riparian zones often overlooked is the influence they have on immediately adjacent habitat. These areas become more valuable to many species for nesting, foraging and cover due to the proximity of the riparian zone.

Cliff and talus slopes: These habitats are very limited within the GSRA. The most extensive and most important habitat of this type in the GSRA occurs on the Roan Cliffs. The Cliffs support a very high density of nesting raptors, including one known and one suspected pair of nesting peregrine falcons. Ledges and caves in this habitat type also provide important roosting sites for bats.

All of these major habitats include a variety of grasses, forbs, lichens and mosses which vary by habitat type. Each habitat type has specific importance to the species in the Region and those values are listed in Appendix G.

3.5.3 Big Game

Big Game Use Areas and Movement Patterns. In the fall, most of the mule deer and elk migrate from the summer range in the high mountain meadows and forests on the Roan Cliffs, Battlements and Uncle Bob Mountain, down through the transition range, to the lower elevation winter ranges below 8,000 feet. During the cold winter months, big game prefer the more southerly aspects where temperatures are warmer and the snow is less deep. Slopes of 15 to 40 percent are preferred and slopes greater than 75 percent receive very little use. Vegetation communities on transition and winter ranges typically range from mixed mountain shrub and pinyon/juniper in the foothills, to low elevation sagebrush and desert scrub habitats in the valleys and along the Colorado River.

The winter range is utilized from late fall until early spring, with December 1 to April 30 the most critical period for deer and elk. During mild winters, most big game are scattered throughout the winter range. However, in severe winters, due to deep snow conditions at the higher elevations, they tend to concentrate in the lowest portions of the winter range, along major drainages, typically in the sagebrush/saltbush and pinyon juniper habitats; Hence the designation of these areas as Severe Winter Range. In Region 4, the CDOW has classified severe winter range as crucial habitat. Reference Maps 3.5-1 and 3.5-2 for the use areas.

The availability of winter range is generally considered the limiting factor to big game populations in western Colorado. Winter range

is also the most frequently impacted by development. For this reason, habitat quality and forage production on winter ranges dictate winter deer survival and thereby determine herd population carrying capacity. Table 3.5-1 describes winter range by land status.

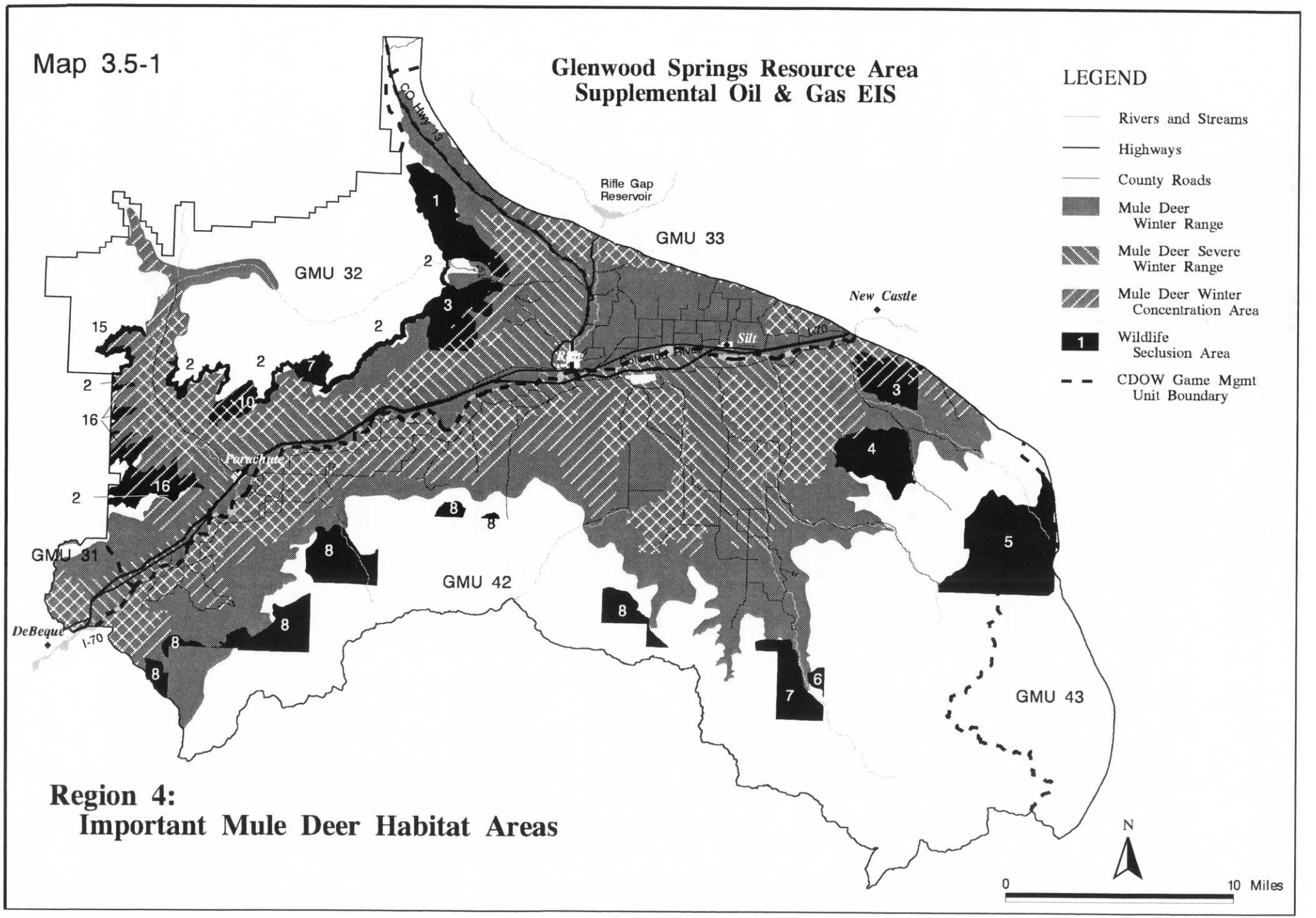
Table 3.5.1 Mule Deer and Elk Winter Range In Region 4 by Land Status

STATUS	Total Surface		Deer Winter Range		Elk Winter Range	
	Acres	%	Acres	%	Acres	%
BLM	100,545	18	67,827	25	65,300	25
NOSR	38,302	7	6,055	1	2,712	1
NOSR/PROD	11,590	2	11,128	2	0	0
SPLIT ESTATE	50,500	9	23,001	8	27,343	10
TOTAL BLM	**200,937**	**35**	**108,011**	**39**	**95,355**	**36**
FOREST	136,418	24	3,726	1	24,702	9
DOE	205	0	205	0	95	0
TOTAL FEDERAL	**337,560**	**59**	**111,942**	**40**	**120,152**	**46**
STATE	3,512	1	3,352	1	3,502	1
PRIVATE	227,476	40	161,168	58	138,135	53
GRAND TOTAL	**568,548**	**100**	**276,462**	**100**	**261,789**	**100**

That portion of the winter range located above the severe winter range does not typically receive concentrated big game use except where winter concentration areas fall outside severe winter range. This upper elevation winter range often provides higher quality forage conditions because of better soils, more moisture, less historic livestock use and more dispersed big game use. Available, quality forage is extremely important to big game during fall and spring migrations. Most big game typically follow the snow level up in the spring, back to the summer range; however, small numbers of deer and elk may use this area year round. During the fall, quality forage assures that big game arrive on severe winter range in optimum physical condition. During the spring, quality forage is important in rebuilding the physical condition of big game, particularly for fawning and calving. Winter range also provides better opportunities for habitat improvement than the severe winter range.

Important Use Areas - Deer. North of the river, GMU's 31 and 32 cover approximately 161,899 acres in Region 4, of which 87,936 acres are deer winter range, including 41,949 acres of severe winter range and 36,692 acres of winter concentration areas (Table 3.5-2). Winter concentration areas extend further up Parachute Creek while severe winter range occurs in lower elevations closer to the Colorado River and Parachute Creek (Map 3.5.1). General movement of the herd is from the summer range on the Roan Plateau, south onto winter range below the Roan Cliffs. Winter concentration area densities in this area support no less than 200 percent more deer than the surrounding winter range. Severe winter range and summer range have both been designated as Crucial habitat in this area.

Based on a refined field mapping of habitat values in GMU 32 undertaken in 1995, the following areas of specific importance to deer survival in GMU 32 were identified - the Magpie Gulch - Sharrard Park area, Cottonwood Gulch,


Map 3.5-1
Glenwood Springs Resource Area
Supplemental Oil & Gas EIS
LEGEND
Rivers and Streams
Highways
County Roads
Mule Deer Winter Range
Mule Deer Severe Winter Range
Mule Deer Winter Concentration Area
Wildlife Seclusion Area
CDOW Game Mgmt Unit Boundary
Rifle Gap Reservoir
GMU 32
GMU 33
GMU 31
GMU 42
GMU 43
New Castle
Silt
Rifle
Parachute
DeBeque
I-70
Colorado River
N
0
10 Miles
Region 4:
Important Mule Deer Habitat Areas

GV Mesa, Hayes Gulch, and Parachute Creek side slopes above the valley floor. See Appendix G for a more detailed description of the areas. These high value areas provide the best remaining winter habitat in the GMU. They typically consist of pinyon/juniper, desert scrub and mixed mountain shrub communities which provide critical food and cover during the winter months. The riparian habitat within these areas also provides important food, cover, water and birthing areas for deer, as well as important values for a number of other species of wildlife. Portions of these areas are basically unroaded and provide seclusion values important for production and escape areas for big game. They also support higher concentrations of other wildlife species due to reduced fragmentation and disruption.

South of the river, in GMU 42, five high value areas have been identified through a cursory review of habitat. They are the Divide Creek/Mamm Creek Basin, Uncle Bob Mountain/Quaker Mesa area, Battlement Mesa, High Mesa/Dry Creek area and Alkali Creek/Sunnyside area. These areas are crucial to the survival of mule deer, elk, turkey and black bear in the unit. Big game migration is primarily between summer and winter range. There is an obvious fidelity shown to the home ranges with not much movement between different sections of the analysis area. Generally, the Battlement Mesa portion of the area is isolated from the rest of the range by low valleys of private lands, resulting in little movement between the Battlement Mesa area and the rest of the unit, although there is some limited movement between the Divide Creek herd and the north side of Battlement Mesa. Again, winter concentration area densities are 200 percent greater than the surrounding winter range density.

All areas defined as severe winter range have been designated as crucial habitat. "A large portion of the deer in GMU 42 winter on private land. GMU 42 is also the major unit in the DAU for production and harvest of mule deer. Winter range densities (per square mile) in GMU 42 are one of the highest in the state." (CDOW, 1995).

Table 3.5-2 Important Big Game Habitat by GMU, Region 4

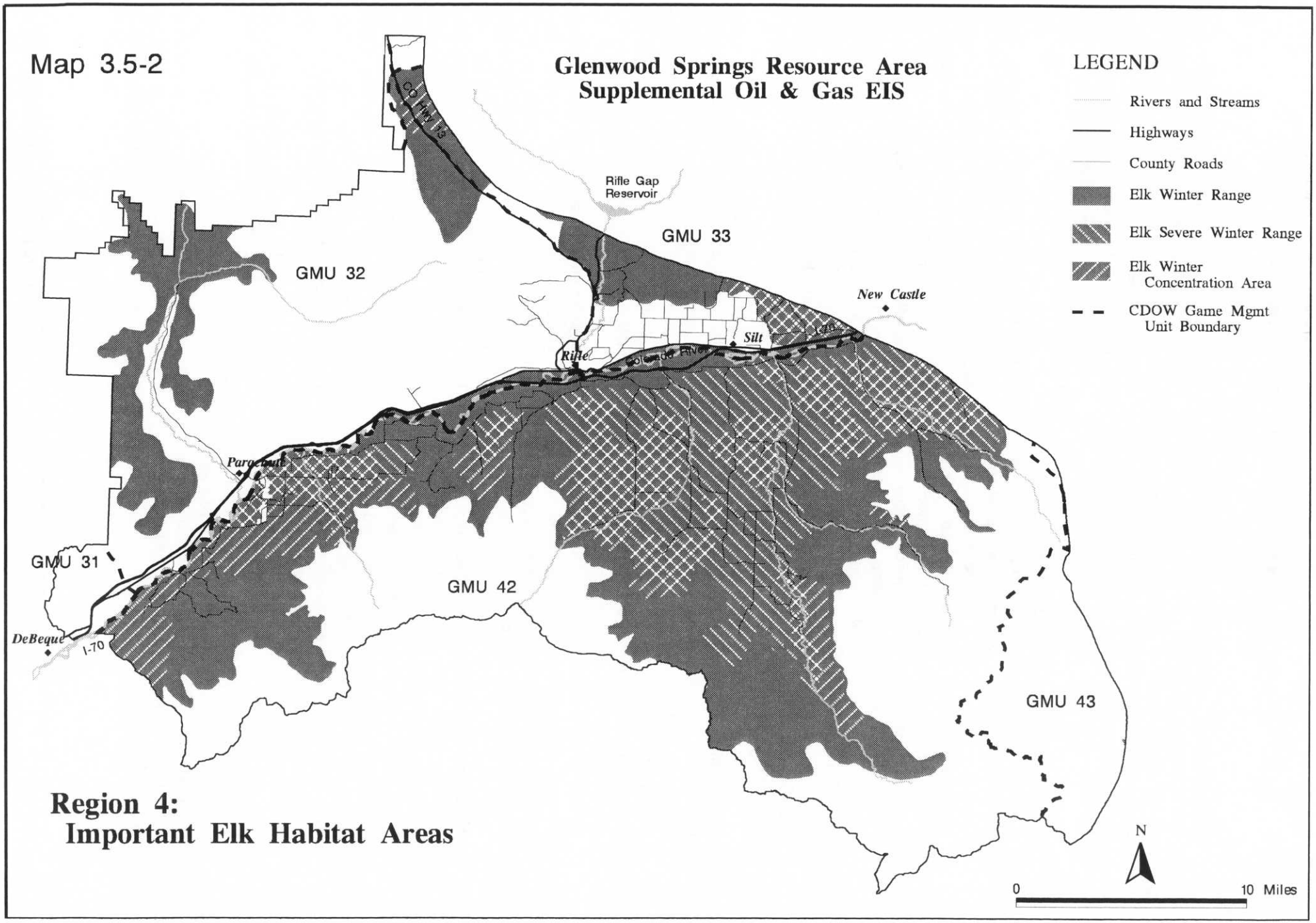
Region 4	GMU 32	GMU 42	Other	Total
Total acres	154,952	340,270	73,326	568,548
Deer WR	81,516	157,860	37,087	276,462
Deer SWR	37,666	69,804	9,313	116,785
Deer WCO	34,392	72,274	8,861	115,527
Elk WR	32,015	210,484	19,291	261,789
Elk SWR	0	94,269	2,978	97,247
Elk WCO	0	61,643	6,180	67,823

WR = Winter Range
SWR = Severe Winter Range
WCO = Winter Concentration Area

Mule deer and elk select higher quality habitat for fawning and calving. These areas typically aren't mapped. However, based on research, it is estimated that much of the fawning activity occurs in, or immediately adjacent to, the riparian areas associated with the major drainages in the winter range, while much of the elk calving occurs in higher elevation aspen sites near water. Some elk calving areas are mapped in WRIS.

Important Use Areas - Elk. Most elk north of the Colorado River winter along Piceance Creek, outside of Region 4, with only small numbers wintering in portions of Parachute Creek. Severe winter range has been mapped as crucial habitat in GMU's 31 and 32.

Summer range was determined to be Crucial habitat, with particular emphasis on water areas and aspen and spruce pockets that are needed for elk cover and production. The Roan Plateau is


Map 3.5-2
Glenwood Springs Resource Area
Supplemental Oil & Gas EIS
LEGEND
Rivers and Streams
Highways
County Roads
Elk Winter Range
Elk Severe Winter Range
Elk Winter Concentration Area
CDOW Game Mgmt Unit Boundary
Rifle Gap Reservoir
GMU 33
GMU 32
New Castle
Silt
Rifle
Parachute
GMU 31
GMU 42
GMU 43
DeBeque
I-70
Region 4:
Important Elk Habitat Areas
N
0
10 Miles

emphasized as a crucial habitat due to its heavy use as summer range. Fall and spring movement of elk mainly tends to be from high summer range on the Roan Plateau, north outside Region 4. Water availability is a critical factor in this DAU due to the xeric climate of the region.

South of the river (GMU 42), the habitat below 8,000 feet is important winter range, with herds of up 1,000 animals wintering in the Mamm Creek/Dry Hollow Area. Severe winter range has been classified as crucial habitat. Their winter habitat overlaps that of mule deer and again includes most of the mixed mountain shrub, pinyon-juniper and semi-desert scrub vegetation communities. Reference Table 3.5-2 and Map 3.5-2 for winter range, severe winter range and winter concentration areas location and size. The high value areas listed for deer are also important for elk.

Of the 568,548 acres of land within Region 4, CDOW has mapped approximately 276,462 (49 percent) as mule deer winter range and 261,789 (46 percent) as elk winter range. BLM has jurisdiction over mineral development on 39 percent of the mule deer winter range and 36 percent of the elk winter range. Reference the Glossary (Chapter 7) for definitions of terms and Table 3.5-1 for a specific breakdown of acres and corresponding winter range.

Mule Deer Population Dynamics. The Rocky Mountain mule deer occurs throughout the mountains and valleys of western Colorado. Mule deer populations have historically fluctuated, periodically affected by drought and severe winter weather. Populations in Region 4 have followed that trend; however, in recent years, their numbers have not rebounded as in the past and loss of winter habitat resulting from development in the western valleys is thought to be at least partially to blame. Elk populations have been expanding throughout Colorado and speculation has also tied the mule deer decline partially to this increase; however, no definitive evidence supports this theory.

The mule deer population has generally been declining in Data Analysis Unit (DAU) D-41, which includes GMUs 31 and 32 (north of the river) and is below the DAU population objective of 16,700 deer. The current population estimate is approximately 16,000 deer, down from a high of 49,000 in 1961.

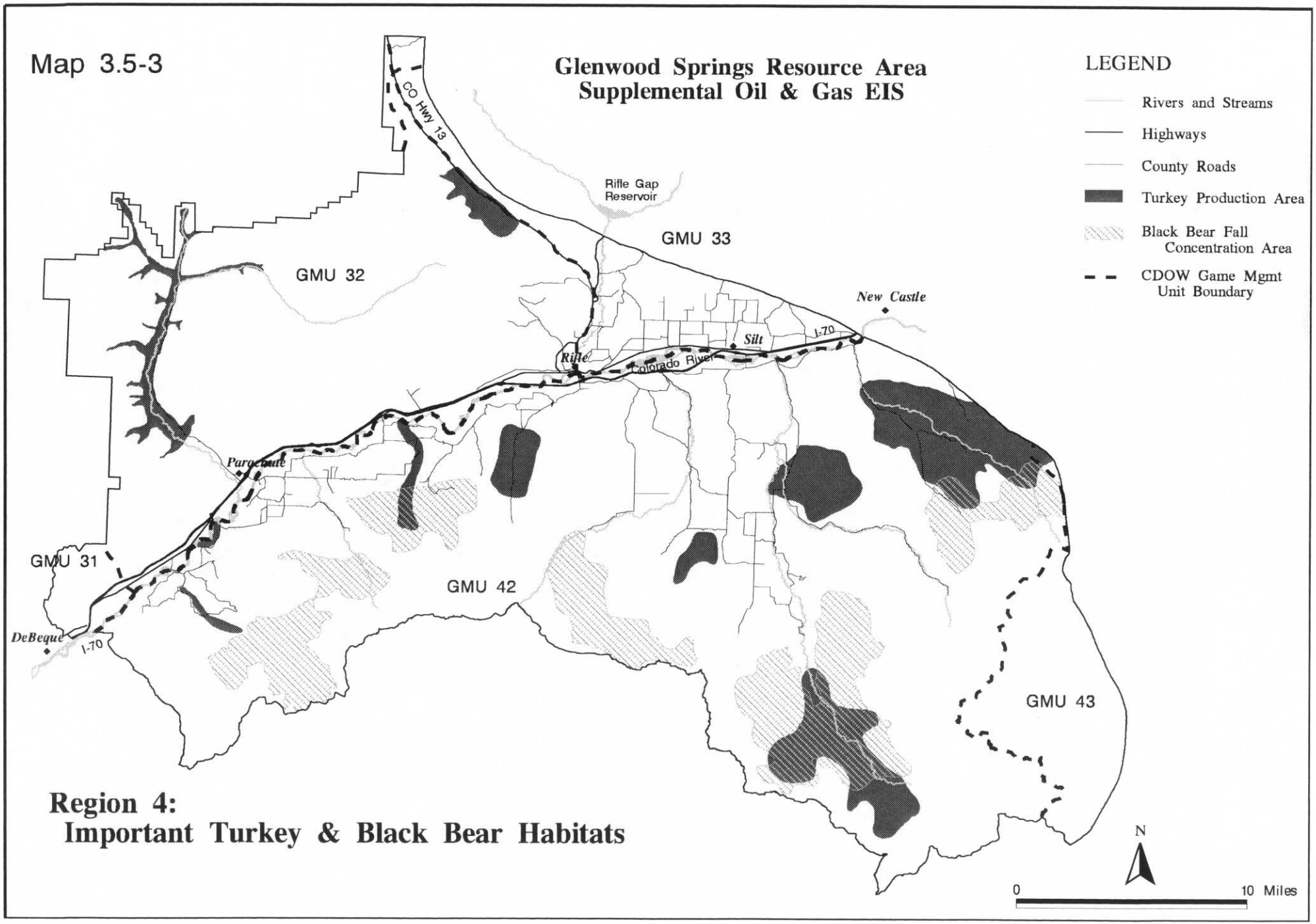
Unocal Corporation initiated a mule deer study in the Parachute Creek drainage in 1982 and has been doing annual surveys since then. Based on this study, the mule deer population peaked in 1987 (a recovery from the 1983-84 winter die off), remained relatively steady until 1990 and has been declining since then. The mule deer decline in East Fork and their continued low population reflects deer population dynamics throughout the Parachute Creek drainage. (Grant, 1997)

Mule deer populations in DAU D-12 which includes GMUs 41, 42 and 421, have also been declining and are presently below the DAU population objective of 29,500. The current population estimate is approximately 26,200 deer, down from a high of 38,000 in 1988.

Elk Population Dynamics. The elk population has generally been increasing in DAU E-10 which includes GMUs 21, 22, 30, 31 and 32. The current population estimate is approximately 6,000 elk, up from 75 in 1972 and double the DAU population objective of 3,000 elk. Although elk populations are increasing in GMU 32, very few elk winter in the Parachute Creek drainage. Most elk move north or west off the plateau top into the Piceance and Roan Creek drainages, thus elk should have only a very limited impact on mule deer in this GMU.

In DAU E-14 which includes GMUs 41, 411, 42, 421, 52 and 521, the population has also been increasing.

The current population estimate is approximately 12,000 elk, down from about 18,000 in 1992 but presently above the DAU population objective of 10,500.



Region 4:
Important Turkey & Black Bear Habitats

Rocky Mountain Bighorn Sheep. A small band of approximately 20-30 Rocky Mountain Bighorn Sheep summers at the higher elevations in the Battlements and winter at the lower elevations along the face of the Battlements. This population has declined from about 50-60 during the past 20 years. Their habitat should be only minimally impacted by gas development as the area of concentrated activity lies totally outside bighorn sheep range.

Mountain Lion. Region 4 sustains a viable population of mountain lions, estimated to be less than 30. They inhabit the upper Roan Plateau, the Battlements and Uncle Bob Mountain and the steep, rugged slopes breaking off the sides. Mule deer habitat typically is mountain lion habitat. The biggest population seems to be in GMU 32.

Mountain lion typically follow their primary food source which includes mule deer, elk, bighorn sheep and other smaller mammals. Increasingly, mountain lion are found to be preying upon elk (Freddy, Pers. Comm.). Populations on public lands are usually at their highest during the winter months when the big game populations are greatest on the winter ranges. Their numbers cycle with the prey base (as do those of most predators). As big game numbers dwindle, lion are forced to shift to other prey bases (domestic livestock, etc.) and will eventually dwindle also. See Appendix G for harvest information on mountain lion.

Black Bear. Black bear inhabit the upper Roan Plateau, Battlements and Uncle Bob Mountain. Numbering about 150, they are scattered across public lands and frequent the more mesic habitat types where they take advantage of the extensive mountain shrub and aspen communities. They are dependent upon mast and berry crops during the fall and aspen buds during the spring periods and consequently tend to concentrate in these habitat types. Fall concentrations occur in the Garfield, Baldy, Divide, Mamm, Spruce, Cottonwood, Battlement and Wallace Creek drainages. They typically den up for hibernation in rocky/talus areas, small caves and under root wads in conifer habitats. Reference Map 3.5-3 for fall concentration areas, the most likely habitat to be impacted by gas development.

An increase in human development and the associated food and garbage increases can cause bears to habituate to humans. This results in major nuisance bear problems which are detrimental to bears and humans alike. A bear conflict area has been mapped in the lower Dry Hollow Creek area. See Appendix G for harvest information on black bear.

3.5.4 Raptors

Raptors are protected both by a variety of Federal and State laws and BLM Policy. Federal laws include but are not limited to the Bald Eagle Protection Act, which also addresses the golden eagle, and the Migratory Bird Treaty Act, which prohibits pursuit, hunting, shooting, killing, trapping, capturing or collecting "by any means or manner." (This includes any disruption sufficient to kill chicks and eggs.) For additional information, reference the Draft "Raptor Management Policy" handbook for the GSRA (Coleman and Wunder, 1995).

The GSRA is inhabited by a wide variety of raptors, including both peregrine and prairie falcon, bald and golden eagles, several species of buteo, accipiters, turkey vulture and owls. Many of these species are year round residents of the resource area and Region 4.

Only three inventories of raptor nest locations have been done in the GSRA. In 1978 and 1979, the most prominent cliffs in the GSRA were inventoried for presence of peregrine falcon, with other cliff nesting species nests mapped. During this same time period, a bald eagle roost/nest inventory was completed. Neither of these inventories has been repeated. During the summers of 1994-96, the most likely northern goshawk habitat was inventoried. Other data available consist of incidental sightings of raptor

nests. Very limited data are available on tree nesting species, especially owls.

3.5.5 Upland Game Birds

Upland gamebirds present in Region 4 include Merriam's turkey, blue, sage and sharptail grouse, and chukar.

Turkey are the most likely to be impacted to any degree by gas development. Their production areas (brood habitat) and winter areas are most likely at risk. Much of this habitat occurs along many of the riparian zones. The Parachute Creek drainage and associated side drainages, Government Creek, Mamm Creek, Divide Creek, Garfield Creek, Beaver Creek, Cache Creek and Wallace Creek have all been mapped as important winter habitat and production areas. Turkey tend to utilize the riparian areas and the mixed mountain shrub and pinyon/juniper habitats immediately adjoining the riparian areas for nesting. The mixed mountain shrub community is vital for their survival as a good portion of their diet is made up of the mast crop from oak. See Reference Map 3.5-3 for production areas.

Both blue grouse and sage grouse occur within Region 4. Blue grouse are typically associated with the aspen/conifer and mixed mountain shrub communities occurring at the higher elevations while sage grouse summer in the sagebrush uplands and historically have wintered in the low elevation sagebrush areas along the Colorado River. Neither species is likely to be greatly impacted as a result of gas development in Region 4.

Small chukar populations can be found north of the river, on the steep slope and talus areas of the Roan Cliffs especially around Smith and Kelly Gulch and within the Parachute Creek drainage, predominantly in Wheeler Gulch. Their populations are low and thought to be dwindling throughout this area. Riparian areas provide nesting habitat and needed free water.

3.5.6 Waterfowl and Shorebirds

Waterfowl occurring in Region 4 include: Canada geese, mallards, teal, mergansers and golden eye, with smaller populations of gadwall and widgeon, to name a few. Most of these birds extensively use the Colorado River, Fravert Reservoir and many of the gravel pits along the Colorado River, including the Parachute Ponds State Wildlife Area. Waterfowl typically nest in willow and grass/shrub understory. Outside Region 4, major waterfowl use areas are the Roaring Fork, Colorado and Eagle Rivers, and the reservoirs on King Mountain.

Shorebirds occurring in Region 4 include the great blue heron, egrets (great, cattle and snowy) and white faced ibis. Great blue heron are dependent upon the tall mature cottonwood stands for their platform nests and they feed in the shallow water in the Colorado River and larger ponds and reservoirs. Several heron rookeries occur along the major river systems in the GSRA. Egrets and ibis are thought to be seasonal migrants.

3.5.7 Predators and Furbearers

A variety of predators and furbearers occur in Region 4. Representatives include bobcat, coyote, red and gray fox, marten, raccoon, badger, skunks, ringtail, beaver, mink, muskrat and weasels. Bobcat and ringtail are most commonly found in the rocky, broken terrain of foothills and canyonlands. Preferred habitats are pinyon-juniper woodlands and montane forests. They can be found throughout the area of concentrated development in Region 4. Their prey in this area generally consists of rabbits, squirrels, mice, small birds, deer and prairie dogs.

3.5.8 Small Game and Non-game Species

A large variety of non-game wildlife also occurs, including mountain and desert cottontail rabbits, snowshoe hare, blacktail and whitetail jackrabbits, ground and rock squirrels,

mice,voles, songbirds, and others too numerous to mention. They can generally be found inhabiting all of the habitats represented in Region 4 with species and numbers varying by habitat type and quality. White-tailed prairie dog complexes exist west of Una alongside I-70 and along the Roan Cliffs from Hayes Gulch to Cottonwood Gulch. Other small populations are found elsewhere in the GSRA. The extent of these complexes is currently undetermined and no inventory has been done to determine the presence of co-existent species such as the burrowing owl or ferruginous hawk.

A large variety of songbirds, including both indigenous and neotropical migratory species, occurs within Region 4, with the greatest variety and abundance typically associated with riparian habitat.

In western Colorado, reptiles occur in a variety of ecosystems, but are most common in the low elevation sagebrush, semi-desert scrub, pinyon/juniper, mixed mountain shrub and canyon habitats. Deep, loose soil, open areas, and rocks are important habitat components for reptiles in the region. At least six snake, eight lizard, and six amphibian species can be found in Region 4. In general, amphibians are limited to mesic areas (streams, ponds, drainages), occurring most often in riparian, wetland and irrigated agricultural areas. In Region 4, stock ponds, numerous gravel pits along the Colorado River, Fravert Reservoir, the Parachute Ponds and most of the streams support a variety of amphibians.

3.6 Special Status Species

An overview of Special Status species in the Glenwood Springs Resource Area is presented in Chapter 3 Page 3-6 and 3-12 of the FEIS. All listed, candidate and sensitive species are referred to as "special status" species. Table 3.6-1 provides a current list of species and their legal designations. A discussion of significant natural plant communities that may also be given special management designation is also included in this section.

The Endangered Species Act of 1973 and its amendments require Federal agencies to insure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or result in the destruction or adverse modification of the critical habitat of the species. Federal agencies shall also use their authorities in furtherance of the purposes of the Endangered Species Act, which is to improve threatened and endangered species to the point where the Endangered Species Act is no longer necessary. The term "endangered species" means any species which is in danger of extinction throughout all or a significant portion of its range. The term "threatened species" means any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Candidate species are those species for which the USFWS has sufficient data to list as threatened or endangered, but for which proposed rules have not yet been issued. Although candidate species are not protected under the Act, it is BLM policy to:

> *"carry out management, consistent with the principles of multiple use, for the conservation of candidate species and their habitats and to ensure that actions authorized, funded, or carried out do not contribute to the need to list any of these species as T/E." (BLM Manual 6840, 1988)*

Furthermore, BLM State Directors may designate sensitive species. By definition, this designation includes species that could easily become endangered or extinct in a State. Therefore, the protection provided by the policy for candidate species is used as the minimum level of protection for sensitive species. Currently, the Colorado BLM has a sensitive plant list. A revision of that list is underway with the addition of a sensitive animal list.

Significant natural plant communities (SNPCs) are natural plant communities that either: 1) are globally rare; 2) are rare within the state; or 3) have not been substantially altered by human activity. The first two categories include vegetative communities in which the individual component species may not be rare but the unique combination of plant species is rare or uncommon. The third category of SNPCs involve plant community types that are significant not because of their rarity but because they represent relatively undisturbed natural communities with few nonnative species.

SNPCs on BLM lands are important for many of the same reasons that special status plants are important. Urbanization, agriculture, and other human activities have greatly altered many of the natural plant communities on private land. Public lands are therefore critical to maintaining the diversity of natural plant communities and biological diversity in general (BLM, F&W 2000, 1992). SNPCs constitute relict areas and may serve as comparison areas to assess public land health and analyze the impacts of human activities. These areas may also be important for future scientific research.

Roads or other surface disturbance lessen the value of SNPCs as reference areas because surface disturbances interrupt the natural processes at work and often serve as conduits for the invasion of noxious weeds and other nonnative species.

The USFWS identifies 11 Federally listed endangered or threatened wildlife or plant species that could potentially occur in Region 4 (Appendix M). These are the black-footed ferret, peregrine falcon, bald eagle, whooping crane, Mexican spotted owl, Southwestern willow flycatcher, razorback sucker, Colorado squawfish, humpback chub, bonytail chub and Uinta Basin hookless cactus. In addition, the USFWS indicates two candidate species are known to occur in Region 4. These are the boreal toad and Parachute beardtongue. BLM has also identified potential habitat within Region 4 for one threatened plant, the Piceance twinpod, and one candidate plant, the Debeque phacelia.

Table 3.6-1 lists all the special status species that were included on the USFWS list, or are either known to occur or have the potential to occur in Region 4. Of these, eight species are listed as Endangered and four species are currently listed as Threatened under the Endangered Species Act; three are candidates for listing as either Threatened or Endangered. The remaining species are considered BLM Sensitive species.

The majority of the sensitive species listed in the table are associated with dry sites with shallow soils, cliffs and rock outcrops and the juniper and desert scrub communities commonly found along the base of the Roan Cliffs, along the Colorado River and Parachute Creek drainage. The Production Area includes a considerable amount of these types of habitat, and several of these species are known to occur there.

In the Glenwood Springs Resource Area, the only areas which have been inventoried for significant natural plant communities are the former NOSR-1 and portions of the Colorado River riparian corridor. An inventory of the Roaring Fork watershed was initiated in 1997 and will continue in 1998. Subsequent inventories of the rest of the Resource Area may discover other SNPCs of concern.

Key to Table 3.6.1: Species Status as Listed in Column 3

FE ..... Federally listed as endangered.
FT ..... Federally listed as threatened.
FC ..... Federal listed as a candidate species
FC (w)..... Federal candidate species warranted for listing
SE ..... State listed as endangered.
ST ..... State listed as threatened.
SC ..... State listed as species of special concern (no legal status)
COBLMS..... Colorado BLM Sensitive
COBLMS (P)..... proposed to be added to Colorado BLM Sensitive list
COBLMS R ..... proposed to remove from Colorado BLM Sensitive list
FS..... Forest Service Sensitive

Table 3.6.1 Special Status Species in Region 4

Scientific Name	Common Name	Status	Habitat	Probability of Occurrence
PLANTS				
Aquilegia barnebyi	Barneby's Colmbine	BLMS ®	Steep limestone slopes or seeps; shale slopes below waterfalls. Mostly found on the Mahogany zone of the Green River Shale Formation; 5500-9000 ft.	Definite
Astragalus debequaeus	Debeque milkvetch	BLMS	Varicolored, fine textured, seleniferous or saline soils of Wasatch Formation- Atwell Gulch Member; 5100-6400 ft.	Definite
Astragalus lutosus	Dragon milkvetch	BLMS ®	Steep, eroding talus slopes and summits of white-shale knolls on the Green River Shale Formation; 5200-9500 ft.	Definite
Astragalus naturitensis	Naturita milkvetch	BLMS ®	Sandstone mesas, ledges, crevices and slopes in pinon-juniper woodlands; 5000-7000 ft.	Likely
Astragalus wetherillii	Wetherill milkvetch	BLMS ®	Steep slopes, canyon benches, and talus under cliffs. Sandy clay soils with sagebrush and juniper; 5250-7400 ft.	Definite
Lesquerella parviflora	Piceance bladderpod	BLMS (P)	Shale outcrops of the Green River Formation, on ledges and slopes of canyons in open areas; 6200-8600 ft.	Likely
Lomatium (Aletes) eastwoodiae	Eastwood desert parsley	BLMS ®	Pinyon-juniper woodlands in sandy soils; 4600-7000 ft.	Likely
Mentzelia (Nuttallia) argillosa	Clay blazing star	BLMS	Steep, eroding talus slopes of shale, Green River Formation; 5800-9000 ft.	Definite
Penstemon debilis	Parachute penstemon	FC	Sparsely vegetated, south facing, steep, white shale talus of the Parachute Creek Member of the Green River Formation; 8000-9000 ft.	Definite

Scientific Name	Common Name	Status	Habitat	Probability of Occurrence
Penstemon harringtonii	Harrington's beardtongue	BLMS	Open sagebrush or less commonly, pinyon-juniper habitats. Soils are typically rocky loams and rocky clay loams derived from coarse calcereous parent materials (basalt); 6800-9200 ft.	Definite
Phacelia submutica	Debeque phacelia	FC	Sparsely vegetated, steep slopes in chocolate-brown or gray clay on Atwell Gulch and Shire Members, Wasatch Formation. Soils often have large cracks because of the high shrink-swell potential of the clays; 4700-6200 ft.	Likely
Physaria obcordata	Piceance twinpod	FT	Barren white outcrops and steep slopes exposed by creek downcutting. Parachute Creek Member of the Green River Formation: 5900-7800 ft.	Unlikely
Sclerocactus glaucus	Uinta Basin hookless cactus	FT	Rocky hills, mesa slopes, and alluvial benches in desert shrub communities; 4500-6000 ft.	Definite
Sullivantia hapemanii var. purpusii	Hanging garden sullivantia	BLMS	hanging gardens; wet cliffs and boulders of various geology; 7000-10,000 ft.	Definite
MAMMALS				
Eudorma maculatum	Spotted Bat	BLMS, FS	Ponderosa pine, pinyon-juniper woodland and shrub desert. Prefers areas with cliffs and water. Old buildings, feeds in open habitat. Canyons.	Likely
Lutra canadensis sonorae	Southwest river otter	SE	Inhabit riparian areas along permanent water of relatively high quality and with abundant food base.	Likely
Mustela nigripes	Black-footed Ferret	FE, SE	Occupies prairied dog towns almost exclusively. Prairied dog prey base in the GSRA unlikely to be large enough to support breeding population.	Unlikely
Myotis ciliolabrum	Small-footed Myotis	BLMS	Canyon country, roosts in mines, buildings, under tree bark, under stones, etc. Hibernates in caves and abandoned mines. Forages among boulders, along cliffs or shrubs and trees.	Definite
Myotis evotis	Long-eared Myotis	BLMS	Ponderosa pine and pinyon-juniper. Roosts in trees, old buildings, abandoned mines, caves. Forages near trees and over water.	Likely

Scientific Name	Common Name	Status	Habitat	Probability of Occurrence
Myotis thysanodes	Fringed Myotis	BLMS	Coniferous forest and woodland. Ponderosa pine, pinyon-juniper, greasewood, saltbush and oak. Roosts in rock crevices, caves abandoned mines and buildings and trees. Hibernates in caves and buildings.	Likely
Myotis volans	Long-legged Myotis	BLMS	Wooded areas of foothills and mountains. Typical habitat is Ponderosa pine, pinyon-juniper, montane shrubs (willows) or well watered sagebrush. Day roosts are in rock crevices, caves abandoned mines and buildings and trees. Night roosts and hibernation in caves, abandoned mines and buildings. Forages over ponds, streams, open meadows and forests.	Likely
Myotis yumanensis	Yuma Myotis	BLMS	Dry, shrubby country but tied closely to water. Pinyon-juniper woodland and riparian woodland in semidesert valleys. Roosts in caves, crevices or abandoned mines and buildings. Forages over water, along streams, over springs, among shoreline or riparian vegetation.	Likely
Nyctinomops macrotis	Big free-tailed Bat	BLMS	Roosts and hunts in canyon and rock outcrops	Likely
Plecotus townsendii pallescens	Townsends (western) big eared Bat	BLMS, FS	Roosts and hibernates usually in caves and abandoned mines; however, may roost in old buildings, tunnels and bridges. Typically feeds along riparian habitat, open areas, edge habitats	Definite
BIRDS				
Accipiter gentilis	Northern Goshawk	BLMS. FS	Breeding: Mixed, often mostly coniferous, forest, open woodland typically in mature aspen, mixed aspen/conifer and in lodgepole pine. Nest in crotch or by trunk, occasionally in aspen.	Definite
Athene cunicularia hypugea	Burrowing Owl	BLMS (P)	Breeding: Grassland, prairie, savanna. Nests associated with mammal burrows, Most commonly with prairie dog towns. Definite seasonal migrant	Likely
Bucephala islandica	Barrow's Goldeneye	BLMS (P), SC	Breeding: near densely vegetated lakes and ponds with abundant aquatic vegetation. Seasonal migrant	Definite
Buteo regalis	Ferruginous Hawk	BLMS (P), FS, SC	Breeding: open country (prairies, plains, badlands) Nests in tree with commanding view, on ground, bank, butte or slope.	Likely

Scientific Name	Common Name	Status	Habitat	Probability of Occurrence
Centrocercus minimus	Gunnison sage grouse	BLMS (P)	Breeding in sagebrush, nests under sagebrush	Unlikely
Empidomax trailli extimus	Southwestern willow Flycatcher	FE	Breeding: Willow (& tamarisk) thickets along rivers and streams. Nests in upright or slanting fork.	Likely
Falco peregrinus anatum	American peregrine Falcon	FE, ST	Nests in high cliffs and hunts along riparian zones, especially the Colo. river and uplands above the Roan cliffs.	Definite
Grus americana	Whooping Crane	FE, SE	Seasonal migrant with sandhill cranes	Definite
Grus canadensis tabida	Greater sandhill crane	ST, BLMS (P)	Breeding in shallow wetlands, freshwater margins. Nests on ground, requires surrounding water or undisturbed habitat. Seasonal migrant	Definite
Haliaectus leucocephalus	Bald Eagle	FT, ST	Nests in tall trees (typically mature cottonwood in this area) along the Colorado River and hunt along the river and adjacent uplands. Seasonal migrant/historic resident	Definite
Lanius, ludoicianus	Loggerhead Shrike	BLMS (P), FS	Open fields, desert scrub and pinyon-juniper stands. Nests on large branches or vine tangles	Definite
Plegadis chihi	White faced Ibis	BLMS	Breeds in marsh, swamps, ponds, rivers-mostly freshwater, nests in aquatic vegetation, usually on ground but occasionally in shrubs or low trees. May be seasonal migrant.	Definite
Strix occidentalis	Mexican Spotted Owl	FT, ST	Breeding: in dense old growth conifer (esp. old growth fir) and deciduous (especially in steep walled canyons). Nests in cliffs and abandoned platform nests of raven, eagle and hawks.	Likely
Tympanchus phasianellus columbianus	Columbian Sharptailed Grouse	SE, BLMS (P), FS	Breeding in grassland, savanna, partially cleared boreal forest, shrubland, sagebrush. Leks usually occur on small knolls. Nests in small depression in grass or under a shrub. May be a seasonal migrant.	
FISH				
Catostomus discobolus	Bluehead Sucker	BLMS (P), SC	Colorado River Basin	Definite
Catostomas latipinnis	Flannelmouth Sucker	BLMS; SC	Colorado River Basin	Definite
Gila cypha	Humpback Chub	FE, SE	Critical habitat-Colo. River-Ruby Canyon west (not in GSRA)	Unlikely

Scientific Name	Common Name	Status	Habitat	Probability of Occurrence
Gila elegans	Bonytail Chub	FE, SE	Critical habitat-Colo. River-Ruby Canyon west (not in GSRA)	Unlikely
Gila robusta	Roundtail Chub	BLMS, SC	Colorado River Basin	Definite
Oncorhynchus clarki pleuriticus	Colorado River cutthroat Trout	BLMS, SC, FS	Colorado River Basin	Definite
Ptychocheilus lucius	Colorado Squawfish	FE, SE	Critical habitat-Colo. River-Rifle west	Unlikely
Xyrauchen texanus	Razorback Sucker	FE, SE	Critical habitat-Colo. River-Rifle west	Definite
REPTILE				
Crotaphytus collaris	Collared Lizard	BLMS (P)	Desert scrub, rocky outcrops, canyonlands	Definite
Crotalus viridis concolor	Midget faded Rattlesnake	BLMS (P)	Desert scrub, rocky outcrops, canyonlands	Definite
Coluber constrictor mormon	Western Yellowbelly racer	None (Proposed by CNHP)	Desert scrub, riparian woodlands	Definite
Lampropeltis trianguhim taylo9ri	Utah Milk snake	BLMS (P)	Pinyon-juniper, grasslands, canyons, arid river valleys	Definite
Opheodrys vernalis	Smooth green snake	BLMS (P)	Riparian areas and mountain shrublands	Likely
AMPHIBIANS				
Bufo boreas boreas	Boreal toad	FC (w), SE	Wetlands	Definite
Rana pipiens	Northern leopard Frog	BLMS (P), FS, SC	Wetlands, ponds, riparian areas	Definite
Spea intermontanus	Great Basin Spadefoot	BLMS (P), SC	Pinyon-juniper, sagebrush, semidesert shrub, dry rocky slopes and canyons	Definite

3.6.1 Special Status Plants

The FEIS discussed only four of the BLM Special Status plants: Parachute beardtongue, Harrington's beardtongue, Debeque phacelia, and Uinta Basin hookless cactus. These were the federally threatened and candidate species known to occur in the Resource Area at that time. The FEIS did not include the BLM Sensitive plants and those plants that were not known to occur in GSRA at the time. Subsequent projects and inventories have discovered new populations and expanded the range of rare plant species within GSRA. Most of these species are concentrated in the western half of Region 4, north of I-70. Five of these species are endemic to the Green River Shale geologic formation. This formation is limited to

the Piceance Basin/Roan Plateau of Colorado and the Uinta Basin of Utah. Of the Special Status plant species, Parachute beardtongue has the narrowest habitat range; it is only known to occur within Region 4.

NOSR (including the Production Area). The variability of elevation, topography and aspect which exists on the NOSR, combined with the unusual geology, has resulted in a great diversity of plant community types. The NOSR supports several unique natural vegetative communities and a high concentration of rare species.

For the relatively small size of the geographic area, the NOSR is extremely species rich. There are only three other areas of comparable size in western Colorado that contain such a richness of rare species. The other three areas include two National Monuments and a National Park. Although the NOSR is clearly of comparable biological significance, it is the only area of the four that does not enjoy protective status such as that afforded to National Parks or Monuments. (CNHP Report, 1997.)

Previous surveys of the NOSR Production Area (1993-1995) did not include Wetherill's milkvetch, Hanging garden sullivantia, Piceance bladderpod, or Piceance twinpod and inventoried only about 9,000 of the 19,000 acres. The previous NOSR survey (1995-1996) did not include any NOSR lands below the rim.

Uinta Basin hookless cactus (Sclerocactus glaucus) is listed as a Threatened species by USFWS. The Uinta Basin hookless cactus is distributed in four counties in western Colorado and in portions of eastern Utah. This species has been found in the extreme western portion of Region 4. Although widely distributed compared to the other rare plants listed below, the individual populations are usually small.

Piceance twinpod (Physaria obcordata) is listed as a Threatened Species by USFWS. This plant has an extremely narrow distribution and is currently found only in Rio Blanco County. However, similar habitat exists in the NOSR.

Parachute beardtongue (Penstemon debilis) appears to be one of the rarest plants in the world. It occurs on steep south-facing talus slopes of the Parachute Creek Member of the Green River Formation. The Parachute beardtongue is a Candidate species for listing under the ESA. It hasn't been listed yet because the species was only recently discovered and until now the threats to the population have been minimal. In the summer of 1996-7, the Colorado Natural Heritage Program (CNHP) conducted a search of much of its potential habitat and succeeded in locating only two new occurrences in close proximity to an already known population. Late in summer of 1997, an additional population was discovered below Anvil Points. This brings the total number of known populations to five, all in Region 4.

Debeque phacelia (Phacelia submutica) is also a Candidate for listing under the ESA. This tiny annual plant has a much narrower distribution than the Federally-listed Threatened species, Uinta Basin hookless cactus. Known populations are centered around Debeque in Garfield and Mesa Counties. This species is known to occur less than one mile west of Region 4 and some potential habitat exists in Region 4.

Arapien stickleaf (Mentzelia argillosa) is found on steep eroding talus slopes of the

Green River Formation in eastern Utah and in Garfield County. It is already known to occur on the NOSR, but more potential habitat remains to be searched. This plant is a BLM Sensitive species.

Debeque milkvetch (Astragalus debequaeus) is concentrated within a 5-mile radius west and south of Debeque in Garfield and Mesa Counties. A disjunct population occurs in the foothills below Anvil Points. This population represents the easternmost extent of its known range and is a good, healthy population. CNHP conducted a status review (reinventory) of the population in the summer of 1997 and found only two or three new occurrences of the species.

Hanging garden sullivantia (Sullivantia hapemanii var. purpusii) is a Colorado endemic and a BLM Sensitive species. The hanging garden sullivantia occurs in 5 counties of western Colorado. In Region 4, populations are known to occur along the Roan Cliffs and in the Parachute Creek drainage.

Harrington's beardtongue (Penstemon harringtonii) is a BLM Sensitive species. Harrington's beardtongue is currently known from five counties in west-central Colorado and was recently discovered in the Beaver and Porcupine Creek drainages in Region 4. This plant is locally abundant within the GSRA but is globally rare and the threats to the species are considered high.

Piceance bladderpod (Lesquerella parviflora) is locally abundant but not widely distributed. The Piceance bladderpod is found on shale outcrops of the Parachute Creek Member of the Green River Formation in Garfield, Mesa and Rio Blanco Counties. Several populations exist in Garfield County just west of Region 4 and one population was found on the Battlement Mesa cliffs at the southern edge of Garfield County.

Special Status Wildlife Species

The FEIS discussed only four of the BLM Special Status Wildlife species for the GSRA: bald eagle, peregrine falcon, razorback sucker and Colorado River cutthroat trout. These were the federally endangered and candidate species known to occur in the Resource Area at that time. The FEIS did not include the BLM Sensitive species and those species that were not known to occur in GSRA at the time. Subsequent projects, inventories and access to data from the CNHP have brought to light new populations and expanded the range of rare wildlife species within GSRA.

NOSR (including the Production Area). The Roan Cliffs provide excellent nesting habitat for a variety of raptors, including the peregrine falcon. Nesting density on these cliffs is one of the highest in the GSRA. Douglas fir stands below the cliffs appear to also provide winter roost sites for the bald eagle. The head of Cottonwood Creek provides one site (Grant, pers. comm.) and although no inventory has been done, casual observations would indicate that other roosts may exist elsewhere in this area.

The dry, rocky habitats below the cliffs are also known to support a variety of reptiles, including the sensitive **midget faded rattlesnake** (Crotalus viridis concolor) and **collared lizard** (Crotaphytus collaris).

American peregrine falcon (Falco peregrinus anatum) has been documented nesting along the Roan Cliffs near the Anvil Points area since 1991. Reports of peregrine falcons are

documented as early as 1972 (*UNOCAL Draft EIS 1986, TRW March 1982*).

Bald eagle (Haliaectus leucocephalus) roosts are also thought to occur in the Cottonwood Gulch and in some conifer stands located high along the Roan Cliffs north of the Colorado River (Val Grant, personal communication).

Remaining portion of Region 4 and the GSRA.

American peregrine falcon (Falco peregrinus anatum) sightings have also occurred throughout Region 4 over the years but to date, no other nest sites have been confirmed. One recent sighting of a pair in the West Fork of Parachute Creek may indicate an as yet unlocated nest in that area (Val Grant personal communication). They tend to hunt the uplands above the Roan cliffs and the riparian areas along the Colorado River and Parachute Creek drainage, as well as the major drainages south of the Colorado river. Another active nest is located on the Colorado River, north of Dotsero and other sightings have been made but no nests documented.

Southwest willow flycatcher (Empidonax traillii extimus) range has been defined with the Colorado River as its northernmost boundary. Wallace Creek was defined as potential habitat; however, surveys have revealed no southwestern flycatchers occupying that habitat at the present time. This is the only area that has been surveyed.

Black-footed ferret (Mustela nigripes) is not known to occur in the GSRA. It is associated with prairie dog towns of several hundred acres in size and those prairie dog towns in the GSRA are typically less than 100 acres in size and widely scattered.

Whooping Crane (Grus americana) and **Greater sandhill crane** (Grus canadensis tabida) are both known to migrate through the GSRA but, to date, no nesting has been observed; however, one or more sandhill cranes summered in the Castle Peak area in 1995.

Southwest river otter (Lutra canadensis sonorae) has been sighted in the Colorado River in the GSRA; however, population sizes and locations are currently undetermined.

Bald eagles (Haliaectus leucocephalus) were historic residents of this area. An historic nest is located in a ponderosa pine along the Roaring Fork River near Cattle Creek and another in a mature cottonwood, along the Colorado River near Webster Hill. Other nests have been constructed over the last 20 years between Rifle and Silt, west of Rifle along the Colorado River, and near the mouth of Cottonwood Creek (Val Grant, personal communication), in mature cottonwood stands. They also built a nest in the West Fork of Parachute Creek uplands in the fall of 1994 (John Broderick – pers. communication).

Currently, bald eagles winter in the Colorado River basin, usually arriving around mid-October and departing around mid-March. During this period, they hunt across the uplands adjacent to the river and the riparian areas along the river and other side drainages flowing into the river. Bald eagles tend to use communal roosts in mature trees, protected from the elements. A number of winter roosts are located in mature cottonwood stands along the Colorado River. Although not mapped, a roost is also thought to occur in the East Fork of Parachute Creek (Val Grant, personal communication). Roost sites are also located along the Roaring Fork river in the mature cottonwood and in a Douglas fir stand above

Glenwood Springs. No roosts have been documented on the upper Colorado river but perch sites are located along it, as well as along the Eagle River and Brush Creek.

Mexican spotted owl (Strix occidentalis) has not been recorded in the GSRA; however, potential habitat exists in the Roan Cliff area, especially up Parachute Creek in the side canyons and in Glenwood Canyon.

Columbian sharptailed grouse (Tympanchus phasianellus columbianus) have been recorded in the NOSR, including the upper elevations of the Production Area in the mixed mountain shrub and sagebrush uplands. They are uncommon throughout the state of Colorado and are listed by the State as endangered and by the BLM as a sensitive species.

Northern goshawk (Accipiter gentilis) is a rare to uncommon resident in this area. Several nests have been located in the GSRA (Castle Peak, Black Mountain, King Mountain, Hack Lake, and Hardscrabble area) and in Region 4, nests have been located in the June Creek area and in the Mamm and Alkali Creek areas on USFS lands. The June Creek area and the NOSR are the only two areas in Region 4 that have been surveyed by the BLM. Goshawks also are known to winter along the Grand Hogback.

Ferruginous hawk (Buteo regalis) historically occurred in Region 4 and there are several recorded nests in the Debeque area and west; however, there are no documented nests in Region 4 currently.

Barrows goldeneye (Bucephala islandica) is most likely a winter migrant. It has been sighted along the Colorado River; however, there are no recorded nests.

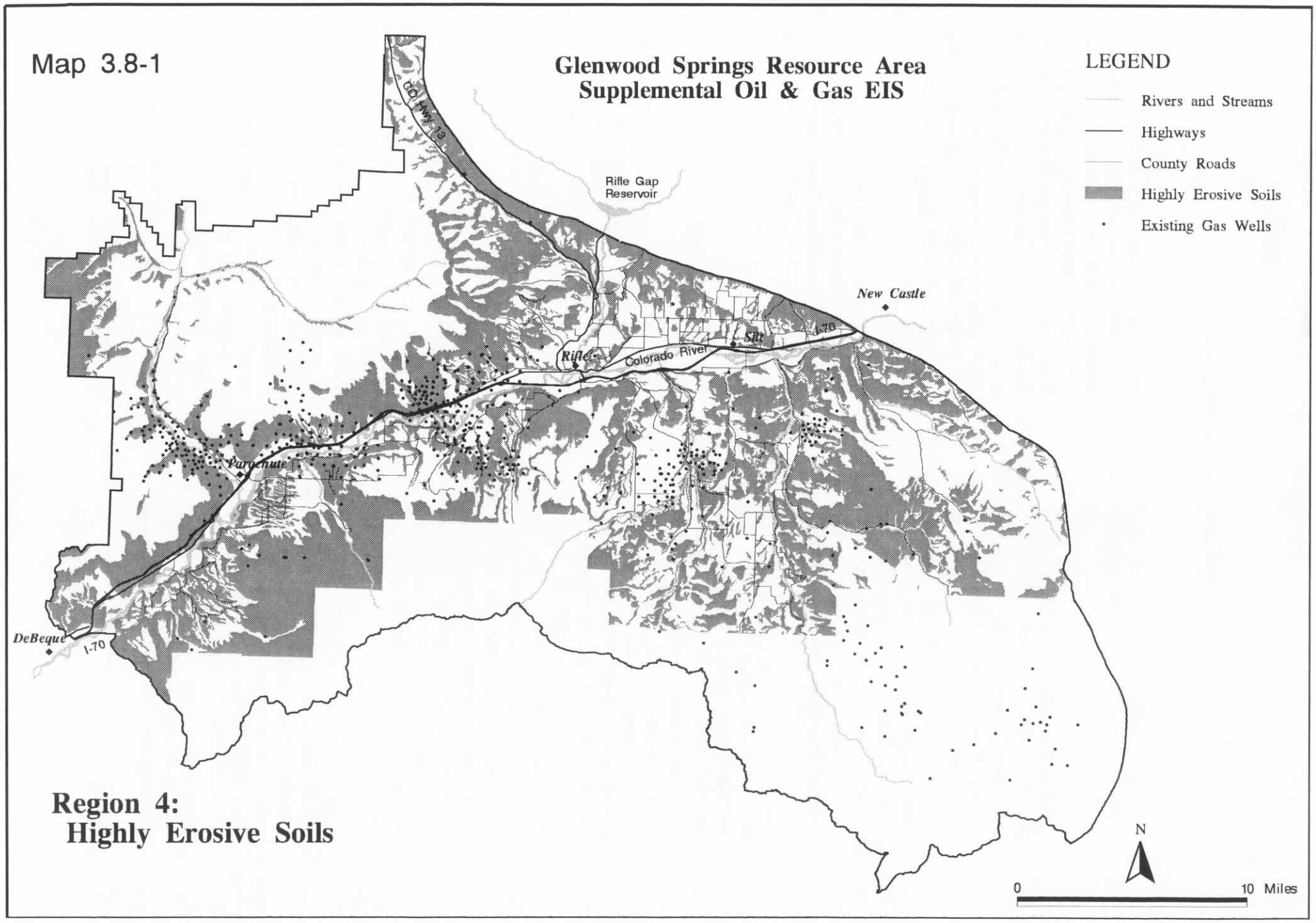
Gunnison sage grouse (Centrocercus minimus) are thought to have historically occurred in the GSRA, at least south of the Eagle and Colorado Rivers. No grouse located in the area south of the aforementioned rivers have been captured in order to determine subspecies; however, evidence of sage grouse is noted almost annually in this area.

Loggerhead shrike (Lanius ludoicianus) have been observed in Region 4 on the NOSR and Grass Mesa; however, no inventory has been done and no nests recorded.

Burrowing owl (Athene cunicularia hypugea) has not been documented except on Onion Ridge as a seasonal migrant. No surveys have been done to document its presence in the GSRA; however, prairie dog colonies do exist in Region 4 in the Una area and below the Roan Cliffs. It does exist in the Grand Junction Resource Area.

White-faced ibis (Plegadis chihi) have been documented throughout the GSRA, usually along the Colorado River and Brush Creek; however, no nests have been documented to date.

Long-eared myotis (Myotis evotis) and **small-footed myotis** (Myotis ciliolabrum)have been found in sludge ponds in Region 4 along with several non-sensitive species. There are no recorded caves in Region 4; however, the Anvil Points mine and several other shafts along the Roan Cliffs may provide suitable habitat and there are ample overhangs, ledges and other suitable habitat within the Region. A large number of caves exist along the edge of the Flattops in the limestone formations. They serve as roost areas and at least, historically, some have served as hibernation areas. These caves,


Map 3.8-1
Glenwood Springs Resource Area
Supplemental Oil & Gas EIS
LEGEND
Rivers and Streams
Highways
County Roads
Highly Erosive Soils
Existing Gas Wells
Rifle Gap
Reservoir
New Castle
Silt
I-70
Rifle
Colorado River
Parachute
DeBeque
I-70
Region 4:
Highly Erosive Soils
N
0
10 Miles

although poorly inventoried, are know to support a diverse range of sensitive bat species.

Other bats recorded in the GSRA include but are not limited to **Yuma myotis** (Myotis yumanensis), **long-legged myotis** (Myotis volans), **fringed myotis** (Myotis thysanodes), **Townsends big eared bat** (Plecotus townsendii pallescens), and **spotted bat** (Eudorma maculatum). Most mines with any length to them, appear to provide at least roosting habitat and those sampled have housed several species of bat although complete inventories have not been done.

Colorado Squawfish (Ptychocheilus lucius), the **razorback sucker** (Xyrauchen texanus), the **humpback chub** (Gila cypha) and the **bonytail chub** (Gila elegans) all have critical habitat designations by the USFWS. For the former two species this habitat extends from Rifle westward, and for the latter two, the habitat extends from Black Rocks in Ruby Canyon, west (outside the GSRA). The bonytail chub is thought to have been extirpated from Colorado. The Colorado squawfish is known to occur below the dams in Debeque Canyon and once the new fish ladders are constructed, will likely extend its range up river into the GSRA. The razorback sucker has been found in gravel pits at Webster Hill and at the head of Debeque Canyon in gravel pits.

Collared lizard (Crotaphytus collaris), **midget faded rattlesnake** (Crotalus viridis concolor), **Utah milk snake** (Lampropeltis trianguhim taylori), and **Western yellowbelly racer** (Coluber constrictor mormon) are all know to occur in Region 4. The **smooth green snake** (Opheodrys vernalis) although not documented in the area, is thought to potentially occur in some of the major riparian areas such as Riley or Cottonwood Gulch. Populations of midget faded rattlesnake are uncommon but have been found from south of Silt, west to at least Rulison and from north of Rifle, west to Parachute and up Parachute Creek. They are usually located near rock outcrops in the foothills below the Roan Cliffs. The collared lizard as been sighted in the Battlement Mesa area and north of the Colorado River in the foothills below the Roan Cliffs.

Boreal western toad (Bufo boreas boreas), **Northern leopard frog** (Rana pipiens), and **Great Basin spadefoot** (Spea intermontanus) can all be found in Region 4 in a variety of locations.

3.7 Wild Horses

The Wild Horses portion of the Affected Environment was discussed on page 3-17 of the FEIS. There are no managed populations of wild horses in the GSRA and they are not discussed in this document.

3.8 Soils

The GSRA encompasses terrain in western Colorado with great topographic relief. The topography often varies from mountains over 10,000 feet to deeply incised river valleys at 5,000 to 6,000 feet elevation in a short horizontal distance. Precipitation and vegetation also vary greatly. Since soil development is a function of parent material, topography, climate, time, and living organisms, soil patterns are complex. Public land in the GSRA is often located on side slopes and in the uplands with highly variable soils. Region 4 is characterized by numerous rock outcrop

escarpments and alluvial/colluvial depositional areas where slopes flatten in the valley bottoms. These rock outcrops and depositional areas also add complexity to the more general soil pattern.

In Region 4, highly erosive soils are often encountered on the steep slopes of the Roan Plateau north of the Colorado River and on the steep slopes of the Battlement Mesa south of Parachute, Colorado. For this SEIS, highly erosive soils are defined as those soils with an erosion rating of severe or very severe. These soil erosion rating are derived from the Natural Resource Conservation Service (NRCS) level 3 Soil Surveys which are incorporated into the BLM's GIS data base. The numeric erosion rate for the various mapped soil associations were then correlated with an earlier NRCS Erosion Condition mapping that included the numeric rates of erosion used in this SEIS.

Soils in Region 4 are separated into 4 erosion classes for this analysis. These classes are "Low," "Medium," "Severe" and "Very Severe." Soil in the "Low" erosion class erodes at a rate of 1 to 2 tons of soil/acre/year; soils in the medium erosion class erode at two to five tons/acre/year, soils in the "Severe" erosion class erode at five to 12 tons/acre/year and soils in the "Very Severe" class erode at 12 to 30 tons/acre/year. All of the erosion rates are estimates for soil erosion under natural conditions. Areas with soils rated "Severe" or "Very Severe" are considered highly erosive.

The listed erosion rates are values designed to show relative amount of natural soil movement. This soil movement may be movement as small as a fraction of an inch to movement of great distances. Soil erosion is a natural process that takes place on all land surfaces. Soil erosion should only be viewed as detrimental when the rate of erosion decreases site productivity or when water quality is degraded.

The GSRA 1984 RMP designated several areas with a disproportionate amount of public land with highly erosive soils as Erosion Hazard Zones. Soils in these areas would require special management consideration when surface disturbing activities are proposed. Only one of the designated Erosion Hazard Zones, the Center Mountain/Divide Creek area, is in Region 4.

The NOSR property includes land on the Roan Plateau where soils are often deep, well drained with moderate slopes, and a moderate rate of soil erosion. However, highly erosive soils are commonly found on the steep south facing slopes of the Roan Plateau within the NOSR production area. Soils in this area are highly varied, shallow to deep, usually well drained, generally lacking vegetative cover, often on steep terrain, and often highly erosive.

3.9 Water

This section supplements the discussion of surface and groundwater in the FEIS on Pages 3-17 and 3-18.

3.9.1 Surface Water

The Glenwood Springs Resource Area lies within the upper Colorado River drainage and includes the Eagle and Roaring Fork River basins. Region 4 encompasses part of the Colorado and Roaring Fork River basins. Smaller perennial streams that drain Region 4 and are tributary to the Roaring Fork River are Fourmile and Thompson Creeks. Perennial streams that flow into the Colorado River include Divide, Mamm, Beaver, Battlement, Rifle and Parachute Creeks.

Peak flow usually occurs in May on the rivers and streams in the Glenwood Springs Resource Area. Large snow pack typically delays the peak flow and low snowpack usually results in an early runoff. Intense summer cloudbursts are common throughout the resource area and can lead to substantial stream flows. Often peak flows on smaller perennial and intermittent streams are a result of summer thunderstorms. Precipitation ranges from greater then 30 inches annually in the higher mountain areas to 10 inches annually along the lower areas along the Colorado River and in the rain shadow around Dotsero, Colorado.

Water quality in streams varies throughout the resource area depending largely on the annual precipitation patterns, vegetative cover, and geology of the watershed. Sediment and salinity are the primary pollutants. In general, surface water quality in the GSRA is good. Surface water in areas of basalt and sandstone formations are a calcium bicarbonate type of good quality with low sediment and salinity yields. Basalt and sandstone formations are often located in the higher terrain in the GSRA. Formations such as the Mancos/Pierre shales, Eagle Valley Evaporite, Green River and Morrison tend to increase sediment, salinity, sulfate and magnesium levels of surface water thereby decreasing water quality. Lower portions of many watersheds throughout the RA have extensive areas with these formations.

During snow melt runoff and especially during intense thunderstorm activity, sediment and salinity yields are likely to be higher than during low flow periods. Vegetative cover also affects the sediment and salinity yield from watersheds. Sparsely vegetated areas tend to yield higher amounts of sediment and salinity during runoff events than would areas with more vegetative cover. During periods of low flow, salinity concentrations are highest in surface waters. However, the total quantity of salt delivered to the stream is the lowest during these low flow periods.

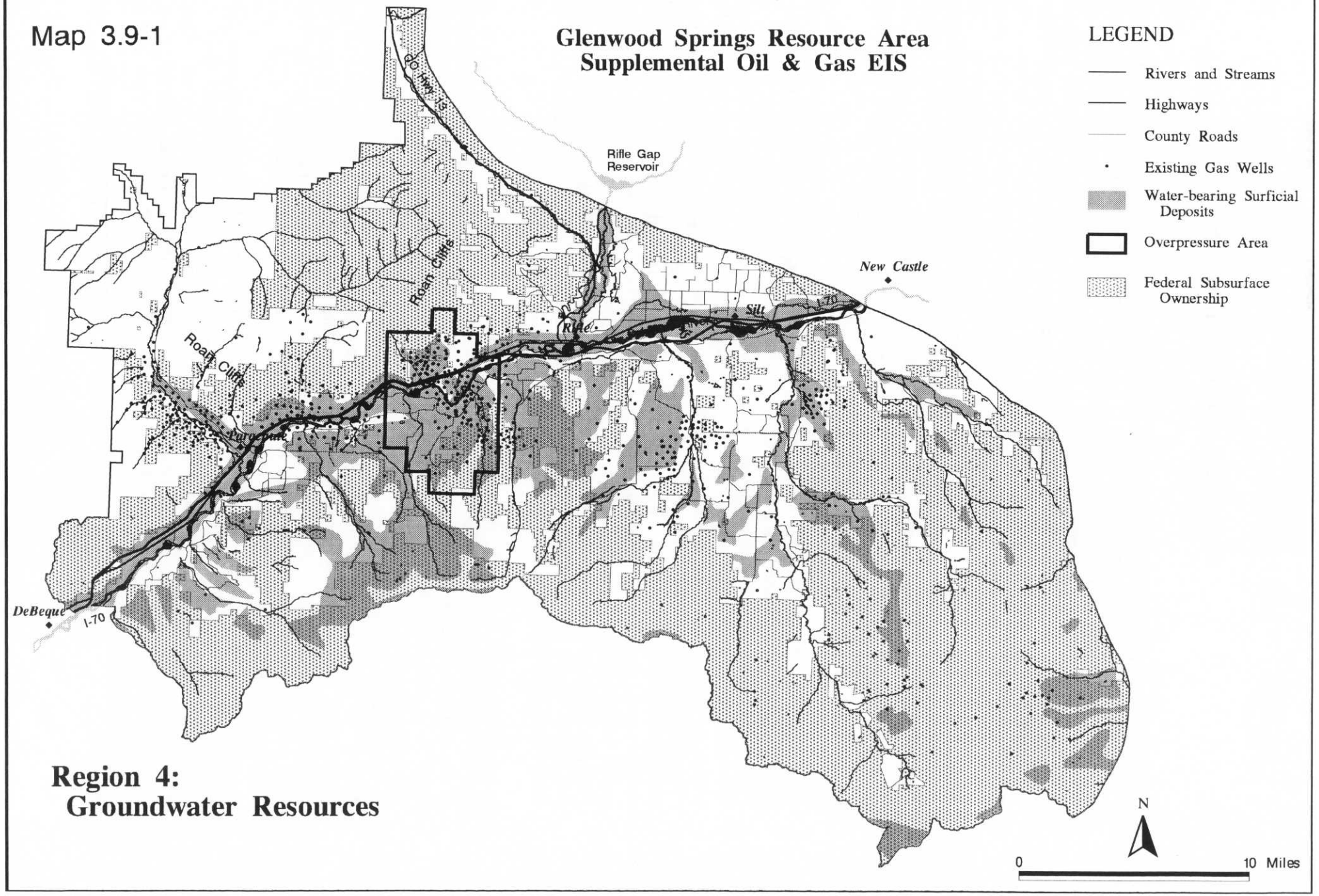
The GSRA RMP designated watersheds that have characteristics requiring special management considerations to protect water quality. These RPM designations are Water Quality Management Areas, Municipal Watersheds and Debris Flow Hazard Zones. Most of the designated watershed areas have low potential for oil and gas development. Only two of these designated watersheds are in Region 4. These two designated areas are the Divide Creek/Center Mountain Water Quality Management Area and the Rifle Municipal Watershed south of Rifle in the Beaver Creek drainage. Oil and gas development has already taken place in both of these watershed areas with no known water quality problems resulting.

As mentioned above, sediment and salt yields are the majors pollutants contributed to surface water. Sediment yield from public land is estimated at 1/4 to 8.4 tons/acre/year and would average an estimated one ton/acre/year in the GSRA (BLM, 1991). At this rate, the estimated total sediment yield contributed to surface water from public land in the GSRA would be 566,000 tons/year. An estimated 57,000 tons of salt are added to the Colorado River annually by runoff from BLM lands in the GSRA. While this may seem like a considerable amount, it is dwarfed by the estimated 500,000 tons of salt that are contributed annually to the Colorado River from hot springs between Dotsero and New Castle, Colorado (BLM, 1984). The Dotsero Hot Springs alone contributes 55,000 tons of salt per year.

Two important factors affecting the amount of sediment and salinity contributed to surface water are the proximity of disturbance to a stream and the maintenance of the vegetative

Map 3.9-1

Glenwood Springs Resource Area
Supplemental Oil & Gas EIS



Region 4:
Groundwater Resources

cover between the disturbance and the stream. Maintenance of riparian vegetation is especially important in the protection of water quality because of these factors. Riparian vegetation functions to armor stream banks and is a filter which helps settle sediment from water before it gets into the stream.

3.9.2 Groundwater

Much of the public land consists of outcrops of the Uinta, Green River and Wasatch Formations. The Green River and Uinta outcrop on the higher elevation area north and south of the Colorado River (Roan Plateau and Battlement Mesa Area), while the underlying Wasatch Formation is exposed elsewhere. The Mesaverde Formation outcrops along the Divide Creek Anticline (mostly USFS lands). Although there may be some minor water zones within the Wasatch, the Wasatch consists of clay, shale and lenticular sandstones and does not generally contain usable water zones. The Mesaverde, which underlies the Wasatch, consists of numerous lenticular sandstones but, except for the Divide Creek area, the formation is generally too deep for drilling domestic wells.

In the Divide Creek area, large quantities of water have been produced from the dewatering of the coal bed methane wells at a depth of about 3,600 feet from the lower Mesaverde. This water is pumped from the coal beds prior to the extraction of the natural gas resource. Because the water is salty in nature, it is injected into the underlying Cozzette and Corcoran Sandstones, which have even lower water quality. No data are available for any shallower water zones in the upper Mesaverde.

The Roan Plateau area of the NOSR, located north of the Colorado River, consists of the Green River and Uinta Formations. Based on spring inventory data, the Parachute Creek member of the Green River and the Uinta Formation contains usable water-bearing zones. Water quality for the upper Uinta water zone tends to be good, while the lower Parachute Creek water zone generally is of poorer quality. The area below the Roan Cliffs and the NOSR Production Area consists of the Wasatch and the lower part of the Green River Formation. These formations are not known to contain significant usable water zones. Hydrologic information from the Garfield County landfill studies indicate that there are no usable water zones within the landfill area.

The hydrogeology on BLM-administered lands within the planning area generally is different from that of private lands in that public lands tend to have less exposures of shallow water bearing surficial deposits. Most of the public lands do not include the stream and river corridors and consequently have fewer alluvial aquifers. The only BLM, Forest Service, or split estate lands with significant surficial deposits are located in the Beaver and Porcupine Creeks, Battlement Mesa, Flatiron and High Mesa areas. Accordingly, there are few water wells located on public lands.

Based on water quality and physical characteristics data obtained from the numerous wells drilled throughout the region, there appear to be multiple aquifers which are not necessarily connected, rather than one continuous regional aquifer. The recharge for these wells appears to be from the Battlement Mesa mountainous area and the other higher elevation areas along the southern portion of the planning area and from the Roan Plateau area to the north.

There are over 300 known domestic water wells within Region 4. Most are located on private lands within the Rulison, Grand Valley, Parachute, Mamm Creek, Beaver Creek, Porcupine Creek, Divide Creek areas and the

NOSR Production Area. Some of the water wells are located in the vicinity of producing gas wells, mostly on private lands. About half of the wells are less than 100 feet deep and generally intersect the alluvial aquifers along the Colorado River, Parachute Creek and the other streams and tributaries throughout the area. The deeper wells range in depth from about 100 to 250 feet, with a few in excess of 400 feet. These are generally located on the slopes and benches south of the Colorado River. The aquifers for these deeper wells appear to be water zones within the unconsolidated surficial deposits, such as the colluvium, talus, landslide or terrace material which overlay the Wasatch Formation.

A water quality sampling of 111 water wells between New Castle and DeBeque and in the Collbran area was conducted during the Summer of 1997 (Water Well Sampling Report for the Piceance Basin of Western Colorado, Greystone, Sept 1997). The results show various levels of the following in the samples: iron, hydrogen sulfide, sodium, potassium, calcium, magnesium, manganese, alkalinity, TDS (total dissolved solids) and low levels of methane. A summary of the evaluation states that several samples exceeded either the Human Health Standards or the Secondary Drinking Water Standards, for chloride, iron, fluoride, pH and sulfates. The BTEX (benzene, toluene, ethyl benzene and xylene) concentrations were found to be below the State of Colorado remedial action levels. Low methane (background) concentrations (less than 0.4 milligrams per liter) were reported in 11 of the sampling locations. There is no established drinking water threshold standard for methane. Overall, no obvious correlation between depths and particular results were noted in the report. Generally, background water quality appears to be variable because of differences in geology, mineralogy, rock types, formations, depths, proximity to recharge areas and aquifer characteristics.

3.10 Forestry

This discussion supplements the Forestry Affected Environment section in the FEIS on pages 3-18 and 3-19.

Within the GSRA, the predominant forest type is Pinon/Juniper woodlands covering about 215,000 acres. Commercial forest lands comprise about 48,000 acres supporting the spruce-fir, lodgepole pine, Douglas-fir, aspen and Ponderosa pine forests.

Pinon/Juniper woodlands are found at elevations ranging from 4,500 to 8,000 feet. Woodland products harvested include commercial and public-use fuelwood, fence posts and transplants. Harvest of Pinon/Juniper has decreased 50 to 65 percent since the mid-1980's because of decreased wood-burning to reduce air quality impacts in mountain communities. Most wood fiber use is limited to fuelwood sales averaging less than 500 cords per year of Pinon/Juniper. Approximately 40 percent (200 cords) of the annual fuelwood harvest can be attributed to personal home-heating use.

The forest resource is generally healthy, although many forest stands are in mature or over-mature condition. Over time, with continued forest management practices, the overall health of the forest resource is likely to remain in satisfactory condition. The Pinon/Juniper woodland type is comprised of stands in all age classes and conditions, but is generally typified by slow-growing mature stands.

Within Region 4, Pinon/Juniper and oak woodlands comprise the forested area below 8,000 feet elevation. Aspen is the primary forest type on the Roan Cliffs with subalpine fir and Douglas-fir growing on north-facing slopes.

3.11 Recreation

This section supplements the discussion of the Recreation Affected Environment on pages 3-20 and 3-21 of the FEIS.

Public lands in the Resource Area provide a variety of outdoor recreational opportunities in settings ranging from rural to primitive. Some public lands contain unique or outstanding recreation values which require special or intensive management top protect recreation values and accommodate public use, and were designated as Special Recreation Management Areas (SRMAs) in the RMP. Management of SRMAs may include restrictions on recreation and other uses to protect the quality of the setting or the visitor's experience. General recreation management classes were also designated for all public lands according to the Recreation Opportunity Spectrum (ROS) classification system. ROS classifications are shown for Region 4 on Map 3.11-1.

There are several SRMAs in the Resource Area but none are found in Region 4. The Upper Colorado and Eagle rivers are managed to provide river related recreation opportunities such as floating and fishing. These river corridors are mainly in rural-natural settings and the scenery is an important part of the recreational experience. Other SRMAs are managed to provide primitive to semi-primitive non-motorized upland recreation opportunities, such as hunting, back country camping, hiking, backpacking and so forth. A predominantly natural character is an important part of the recreational setting in these areas, which include Deep Creek, Bull Gulch, Hack Lake, Thompson Creek, Castle Peak and King Mountain. Table 3.11-1 shows the SRMAs and the recreation management classification. A developed City of Rifle park on patented land is underlain by federal minerals and is protected from potential impacts from gas development, but it is also outside Region 4.

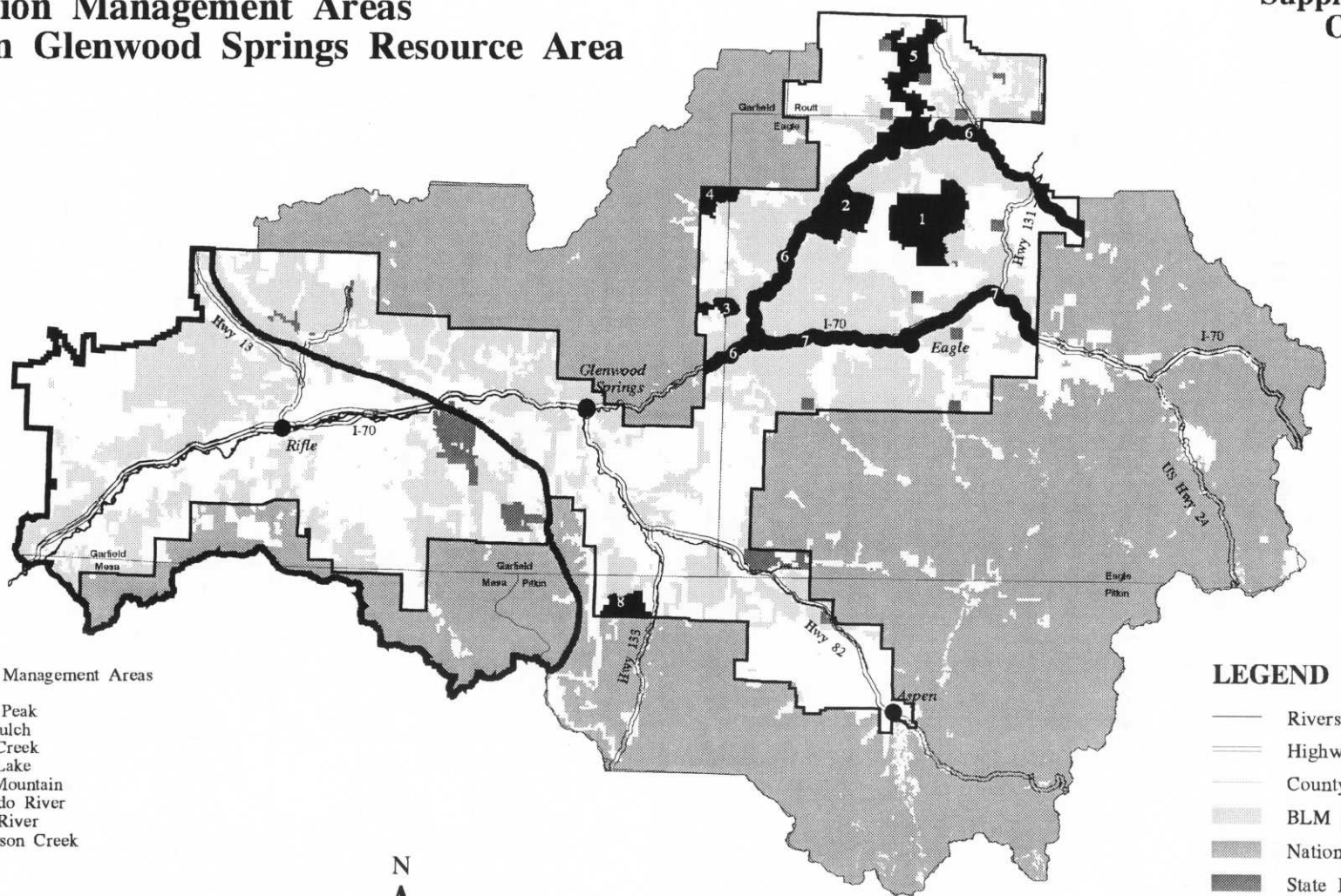
In Region 4, public lands mainly provide opportunities for dispersed recreation in rural to semi-primitive motorized settings. Predominant activities include big game and small game hunting, undeveloped camping, OHV riding and driving around on back country dirt roads sightseeing. Public land river access sites on the Colorado River are very limited. There are a few relatively small areas of public land containing semi-primitive non-motorized qualities but they are not presently managed for those values. These areas exist mainly due to the lack of vehicle access; either because of the lack roads or lack of legal public access on the existing roads.

The wells, access roads and pipelines related to gas development modify the landscape and the quality of recreational settings, and generally conflicts with recreation sites and areas managed to provide primitive or semi-primitive non-motorized recreation opportunities. The character of the landscape in these areas is managed to provide a predominantly unmodified natural setting. Gas field development is more consistent with semi-primitive motorized and roaded natural settings where the character of the landscape may include some substantial modifications of the landscape. Concentrated gas field development with widespread modifications of the landscape is more consistent with of rural and urbanized settings where a variety of

Map 3.11-1

Recreation Management Areas within Glenwood Springs Resource Area

Glenwood Springs Resource Area Supplemental Oil & Gas EIS



Recreation Management Areas

1 - Castle Peak
2 - Bull Gulch
3 - Deep Creek
4 - Hack Lake
5 - King Mountain
6 - Colorado River
7 - Eagle River
8 - Thompson Creek

N

0 25 Miles

LEGEND

- Rivers and Streams
- Highways
- County Lines
- BLM Land
- National Forest Land
- State Land
- Private Land
- Region 4 (High Potential for Oil and Gas Development)
- Recreation Management Areas

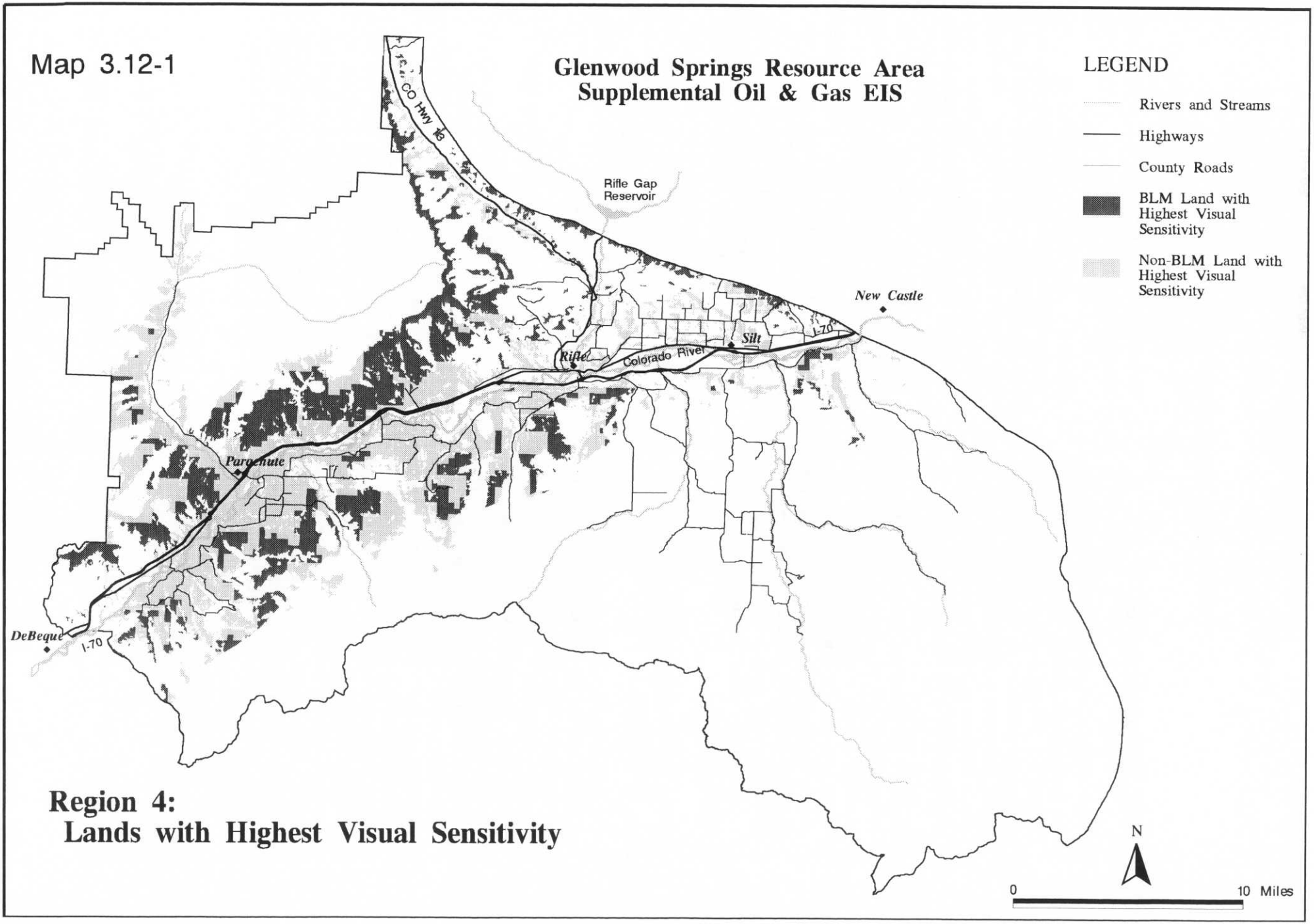
land use practices are obvious. Table 3.11.2 summarizes the acreage by recreation management class designation for public lands in the GSRA and Region 4. Inventory classifications are included for private lands in Region 4 because the character of private lands affects the values found on public land, but BLM management objectives do not apply on private property. Appendix H describes the objectives for managing the setting in each recreation management class.

Table 3.11-1 GSRA Public Land Under Special Recreation Management Areas

Recreation Management Area	Size (Acres)	Recreation Management Class
Bull Gulch	9,839	Primitive, Semi-Primitive Non-Motorized
Castle Peak	20,128	Semi-Primitive Non-Motorized
Colorado River, Upper	21,618	Rural, Roaded Natural
Deep Creek	2,406	Primitive, Semi-Primitive Non-Motorized
Eagle River	8,415	Rural, Roaded Natural
Hack Lake	3,336	Semi-Primitive Non-Motorized
King Mountain	12,000	Semi-Primitive Non-Motorized
Thompson Creek	4,270	Semi-Primitive Non-Motorized

Table 3.11-2 GSRA Recreation Management Classes

Recreation Management Class	Resource Area BLM Total (Acres)	Region 4 BLM (Acres)	Region 4 NOSR Production Area (Acres)	Region 4 Split Estate (Acres)	Region 4 Private (Acres)
Primitive	597	0	0	0	O
Semi-Primitive Non-Motorized	37,180	837	0	1,487	1,533
Fall Only, Semi-primitive Non-Motorized	3,848	0	0	0	0
Semi-Primitive Motorized	250,314	47,356	0	15,174	54,023
Roaded Natural	236,425	82,840	11,407	22,471	159,835
Rural	29,214	7,792	183	1,865	35,167
Urban	424	2	0	0	4,475



Region 4:
Lands with Highest Visual Sensitivity

3.12 Visual Resources

The landscape in Region 4 contains outstanding scenic qualities and is highly visible from several key viewing areas. Public sensitivity to landscape modifications is high, and current visual resource management objectives for public lands are aimed at retaining the existing character of the landscape.

Region 4 was evaluated to identify landscape features that are at greatest risk of being adversely affected by gas development activities due to high visual sensitivity. Visual sensitivity values were based on a combination of visual exposure and viewing distance, with areas that are visible form many locations at close range considered the most sensitive to landscape modifications.

3.12.1. Landscape Character and Scenic Quality

Region 4 is on the western edge of the Southern Rocky Mountains' physiographic province. The predominant vegetation types are Juniper-Pinyon woodland, Sagebrush, Saltbush-greasewood, Mountain Mahogany-Oakbrush, and Western Spruce-Fir with aspen in the upper elevations. Overall landscape variety is high and contains many outstanding features. Scenic quality was rated Class B and A in visual resource inventories conducted by the BLM in 1979. Region 4 is mainly composed of a broad stretch of the Colorado River valley, bordered by mesas, terraces, foothills and steep mountain slopes. The Roan Cliffs are outstanding landforms which provide a dramatic backdrop in the scenery of much of the river valley in the western part of Region 4. Overall topographic relief is considerable, with the skyline rising over 4,000 feet above the valley floor in places. Numerous side drainages and gulches dissect the landforms, adding to the variety and topographic texture.

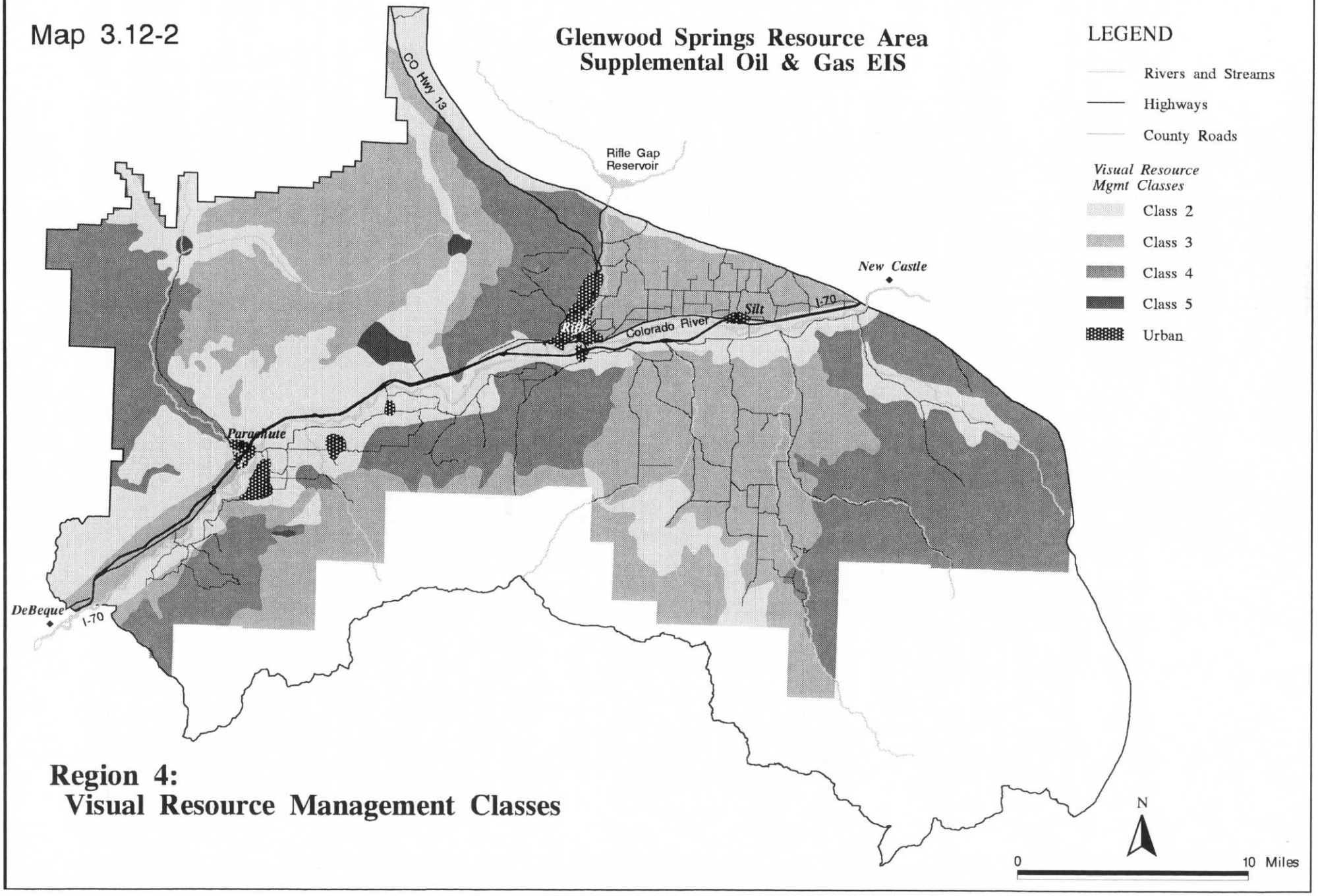
Existing landscape modifications are characteristic of rural agricultural-ranching land uses, transportation, utilities and small towns, with gas field development becoming increasingly noticeable. Scattered rural residences are evident in the valley and adjacent terraces, mainly east of Battlement Mesa. Concentrations of residences are found at Battlement Mesa, Holms Mesa, Taugenbaugh Mesa, Silt Mesa, and in and around the towns of Rifle, Parachute, Silt and New Castle. Irrigated hayfields, orchards and dry-land pastures are found throughout the valley and mesas. Gas development modifications are most evident along Interstate 70 between Parachute and Rifle, particularly in Sharrard Park, Webster Mesa, and along Parachute Creek where many well pads, tank batteries, compressor stations and related pipelines and roads are located. Gas development is becoming noticeable on the slopes in the Porcupine Creek basin, where new wells are being developed.

3.12.2 Key Viewing Areas and Viewsheds

The viewing areas are Battlement Mesa, Highway 13, Holms Mesa, Interstate 70, Parachute Creek Road, and the Town of Rifle. The landscape seen from these viewing areas is affected by existing gas development and includes areas that are most likely to be affected by future development. Interstate 70 and Highway 13 are important because Region 4 is a significant part of the scenery along these routes, with their high viewing volume. The other viewing areas are important because

Map 3.12-2

Glenwood Springs Resource Area
Supplemental Oil & Gas EIS



Region 4:
Visual Resource Management Classes

they are populated areas; residents experience the scenery of Region 4 daily.

'Viewsheds' were delineated for the key viewing areas with an automated program using a 30 meter cell digital elevation model to show the lands that are seen from each viewing area and indicate the relative exposure of landscape features, with visibility limited by topographic screening. Because of the open character of the landscape, many views range from the immediate foreground to over 15 miles, depending on the location. A complete set of individual 'viewshed' maps is on file in the GSRA office.

As shown in Table 3.12-1 below, public lands are an important part of the field of view in all of the 'viewsheds', but private lands make up the majority of the visible landscape.

Table 3.12-1 Landscape Visibility and Ownership, Region 4 *(in acres)*

VIEWSHED	Total	BLM	BLM/ NOSR	NOSR/ PROD	PRIVATE	FOREST	STATE	SPLIT ESTATE
Battlement Mesa	30,141	7,022	520	4,013	16,955	610	0	1,021
Highway 13	123,231	30,466	7,459	1,014	50,440	18,891	2,010	12,951
Holms Mesa	45,682	8,571	2,164	7,689	23,374	1,781	0	2,103
I-70	185,384	42,232	7,279	8,595	90,944	21,664	1,647	13,023
Parachute Creek	47,637	10,084	218	1,822	29,518	2,815	0	3,180
Rifle	68,551	18,847	3,830	1,345	29,871	7,641	682	6,335

3.12.2. Visual Exposure and Sensitivity

Visual exposure and viewing distance were evaluated to determine visual sensitivity. Landscape features that are visible from many locations in a given viewing area are considered more important than those that are seen from only a few places. Visual exposure is mainly influenced by the character of the terrain, with some features highly exposed to viewing because of elevated location, orientation or lack of screening while others are largely hidden from view. Landscape modifications in these highly exposed areas would be prominent and noticeable from many places. Visual exposure maps with classifications ranging from 'seldom-seen' to 'very high' for each 'viewshed' are on file.

As viewing distance increases, landscape features become smaller, lose resolution and become part of the broader scenery. Greater visual sensitivity is given to areas that are viewed at close range where details of landform and vegetation features can be easily discerned and the visual contrast of modifications can be readily noticed by the casual observer. The foreground distance zone, extending up to three miles from the observer, is of greatest importance and careful attention to visual contrasts of management activities is needed to avoid visual impacts that attract attention. The middle ground from three to five miles is of lesser importance in most instances, but large scale and linear projects can have noticeable visual impacts which could attract attention and detract from natural landscape qualities. The background zone beyond five miles is of relatively little importance in visual resource

management, except in extreme cases where major landscape modifications are involved, such as in large scale, extensive earthwork or vegetation treatment that may affect a noticeable portion of the field of vision.

Landscape modifications related to gas development can be noticeable and attract attention in the foreground and middle ground distance zones because of the relatively large scale of surface disturbance required for well pads, access roads and pipelines. Distance zones were delineated for each key viewing area, and a composite of the foreground zone is shown in maps on file.

Visual sensitivity was determined for each 'viewshed' using the visual exposure and viewing distance criteria indicated in Table 3.12-2 below. Visual sensitivity values provide a measure of concern for maintaining visual qualities. Map 3.12-1 is a composite map of areas with the highest visual sensitivity from all viewing areas. Visual sensitivity maps for each key viewing area are on file.

Table 3.12-2 Landscape Sensitivity, Region 4
Visual exposure and viewing distance criteria used to determine visual sensitivity.

VISUAL EXPOSURE	VIEWING DISTANCE			
	NEAR FOREGROUND	FOREGROUND	MIDDLE GROUND	BACKGROUND
VERY HIGH	Very High	Very High	High	Moderate
HIGH	Very High	Very High	High	Moderate
MODERATE	High	High	Moderate	Low
LOW	Moderate	Moderate	Moderate	Low
SELDOM SEEN	Moderate	Moderate	Low	Low
NOT SEEN	Low	Low	Low	Low

3.12.4 Current Visual Resource Management

Current Visual Resource Management (VRM) objectives were established in the 1984 Resource Management Plan and are generally aimed at protecting the most scenic public lands, especially those lands that receive the greatest amount of public viewing. Current VRM Classes place less emphasis on areas of relatively common scenery that are seldom seen by the public or are visible in the background. With a couple of exceptions, current VRM Classes are mainly aimed at protecting visual resources on public lands seen from I-70.

Map 3.12-2 shows the current VRM classes for Region 4. Table 3.12-3 shows the acreage under each Class by land status. Visual resource management objectives do not apply to non-BLM lands, but visual concerns may be addressed on split estate where federal minerals occur. VRM classes shown for non-public lands are an indication of the visual values for those lands, and those values are only protected by landowner discretion. The classes range from Class I, the highest, to Class V. The management objectives for the various VRM classes are described Appendix H.

Table 3.12-3 Current VRM Classes, Region 4 *(in acres)*

OWNERSHIP	CLASS II	CLASS III	CLASS IV	CLASS V
BLM	24,928	29,511	45,846	234
BLM NOSR	4,248	32,884	827	340
NOSR-Prod	9,645	587	12	1,345
Forest	65,834	5	1	0
Private	65,834	101,899	81,232	774
State	2,828	4	9,814	0
Split Estate	696	44	8427	0

3.13 Cultural Resources

This section supplements the discussion of cultural values in the FEIS, 3-23 and 3-24.

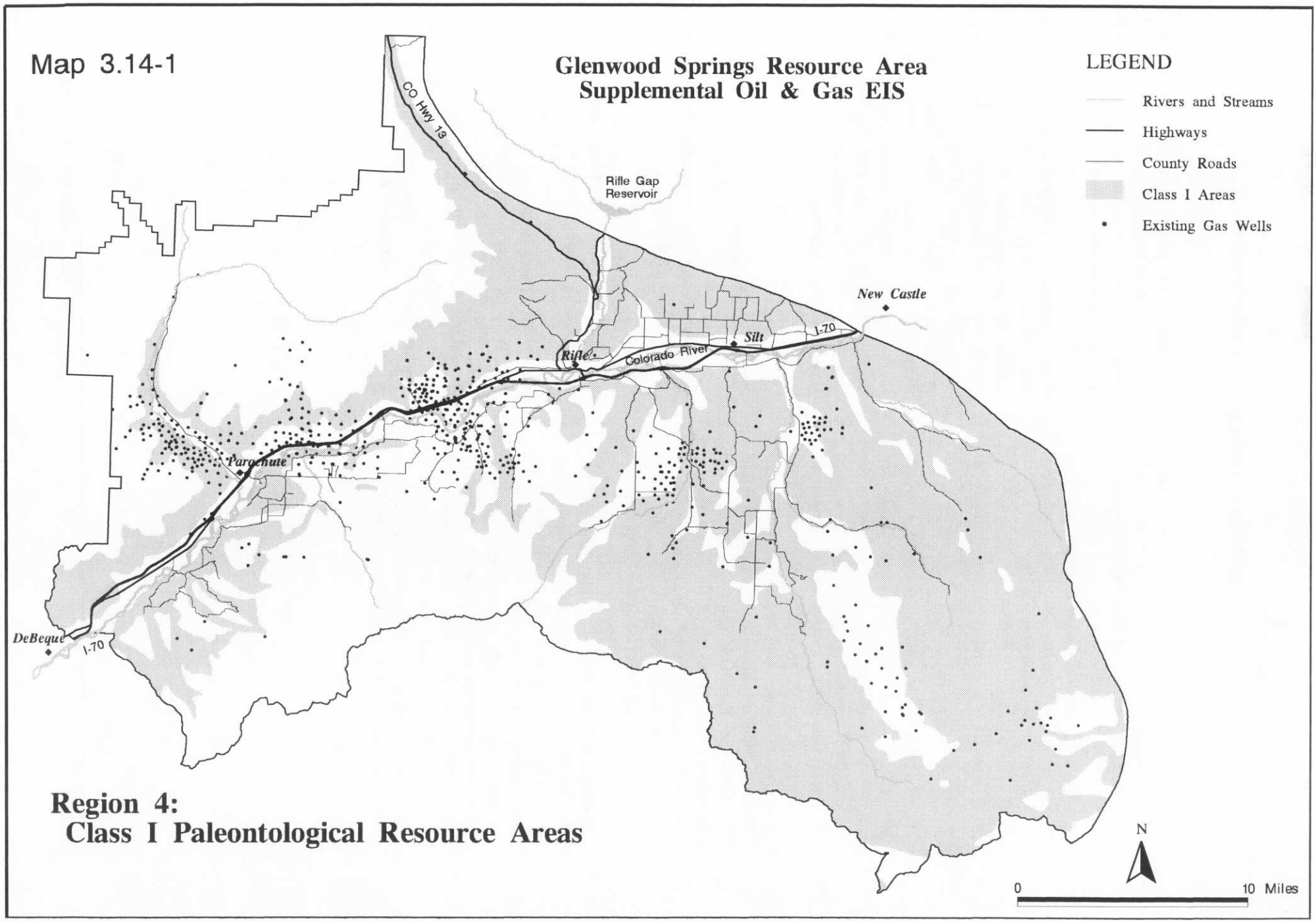
Cultural resources include prehistoric and historic archaeological and architectural resources and traditional cultural and religious properties. In the GSRA, cultural resources, both known and unidentified, include lithic scatters, quarries, temporary camps, extended camps, villages, rockshelters, wickiups, hunting sites, kill/butchering sites, processing areas, tree scaffolds, eagle traps, vision quest sites, caves, petroglyph/pictograph panels, trails, toll roads, wagon roads, water ditches, reservoirs, bridges, homesteads, ranches, cabins, mills, railroads, transmission lines, mines, trash dumps, aspen art, race tracks, vapor caves, isolated artifacts, traditional cultural properties, sacred/religious places, and graves. These resources span approximately 12,000 years and represent use in the area by Paleo-Indian, Archaic, Ute, and Euroamerican cultures.

Several important cultural resources are located in the GSRA. The archaeological ACEC, covering 4,178 acres outside of Region 4, contains a high density of significant cultural resources, especially from the early Archaic period. Another area also outside Region 4, includes a variety of sacred sites and traditional cultural properties that have religious value for the Ute people and are also archaeologically important. A wickiup village, within Region 4, once had over 30 standing conical wooden houses probably built in the early 1800s. Wickiup villages of this size are rare and wickiup sites, or even Ute sites, with historic artifacts are very rare. Native American sites with historic artifacts are important for providing baseline information from which archaeologists can trace back known cultures and compare prehistoric sites in order to examine cultural changes.

3.14 Paleontological Resources

This section replaces the discussion of paleontological resource in the FEIS on pages 3-24 and 3-25.

Paleontological resources include vertebrate, invertebrate, and plant fossils found in formations throughout the GSRA. The geology of the GSRA spans roughly 1.8 billion years. The geologic formations have been classified to indicate the potential for scientifically important fossils. Classification of formations or members of formations may change as data become available.


Map 3.14-1
Glenwood Springs Resource Area
Supplemental Oil & Gas EIS
LEGEND
Rivers and Streams
Highways
County Roads
Class I Areas
Existing Gas Wells
CO Hwy 13
Rifle Gap
Reservoir
New Castle
Silt
I-70
Rifle
Colorado River
Parachute
DeBeque
I-70
N
0
10 Miles
Region 4:
Class I Paleontological Resource Areas

- Class I - Areas known or likely to produce abundant scientifically important fossils vulnerable to surface-disturbing activities.

- Class II - Areas showing evidence of fossils but unlikely to produce abundant scientifically important fossils.

- Class III - Areas that are unlikely to produce fossils.

The Class I formations in the GSRA where scientifically important vertebrate fossils are known to occur are, from the youngest to the oldest, the Wasatch, Morrison, Chinle, and State Bridge Formations. Scientifically important invertebrate fossils are known from the even younger Parachute Creek member of the Green River Formation at a stratigraphic location between the R-6 Oil Shale Zone and the Mahogany Zone between Rifle and DeBeque and the southern rim of the Piceance Creek Basin. It is easily recognized as the steep whitish cliffs near the crest of the Roan Plateau.

The Eocene Green River Formation, particularly the Parachute Creek member, includes fossil insects (over 100 species), plants, gar and other fish, turtles, and crocodilians (with gastroliths - stomach stones). An invertebrate collection from this formation in the GSRA is curated at the Smithsonian Institution and studied by scientists from around the world since it represents about ninety percent of all known Cenozoic insect orders and exhibits great bio-diversity. The collection is also important for investigations of interactions between plants and insects. The formation is in the NOSR Production Area of Region 4.

The Paleocene Wasatch Formation includes early horses, rare primates, rhinoceroses, birds, crocodiles, rodents, fish, turtles, fresh water clams, snails, and plants. The Jurassic Morrison and Triassic Chinle Formations include dinosaurs. The Paleozoic State Bridge Formation has vertebrates and invertebrates. There are no paleontological ACECs in the GSRA; however, Sharrard Park contains a high density of scientifically important paleontological resources.

3.15 Wilderness

This section replaces the section on wilderness in the FEIS on page 3-25.

Wilderness inventories completed in 1980 identified four Wilderness Study Areas (WSAs) in the GSRA, none of which are located in Region 4. Wilderness recommendations for the WSAs were made through the RMP completed in 1984, and were submitted to Congress in 1991, but no designations have been enacted. Pending wilderness legislation, WSAs are under interim management to protect wilderness values. Table 3.15-1 shows the WSAs, size and wilderness recommendations.

Table 3.15-1 GSRA Wilderness Study Areas

WSA Name	Size (Acres)	Recommended for Wilderness	Not Recommended for Wilderness
Bull Gulch (CO-070-430)	15,201	10,414	4,787
Castle Peak (CO-070-433)	12,237	0	12,237
Eagle Mountain (CO-070-392)	312	312	0
Hack Lake (CO-070-425)	10	10	0
Total	27,760	10,736	17,024

The size of some of the WSAs shown in the table differs slightly from that shown for the same areas in previous planning documents due to more accurate area calculations recently completed.

Under current management, public lands in the WSA's are not available for leasing, and they contain no current leases. Lands released by Congress for uses other than wilderness would become available for leasing subject to stipulations in effect at the time of leasing.

The Colorado Environmental Coalition (CEC) recently proposed wilderness designation for approximately 43,919 acres of BLM land in the Resource Area, including the 27,760 acres in the WSAs and additional lands in the Hack Lake SRMA and Thompson Creek and Deep Creek ACECs (Conservationists' Wilderness Proposal for BLM Lands, January 1, 1994). None of the conservationists' proposed wilderness areas are in Region 4, and oil and gas development within these areas is either constrained by interim management of the WSAs, NSO stipulations in the ACECs, or by a CSU stipulation to protect VRM Class II scenic values.

Current policy established by the Colorado State Director in 1997 (IM CO-97-044, May 19, 1997) holds discretionary actions in conservationists' proposed wilderness areas, such as oil and gas leasing, temporarily in abeyance until the wilderness issues are addressed and resolved through the BLM planning process. This policy provides for a review process to consider potential wilderness values whenever an action is proposed which might have irreversible or irretrievable impacts within the conservationists' proposed wilderness areas that are not already constrained under current management. The review process would evaluate potential wilderness values and determine if an RMP amendment is warranted to consider protection of those values.

Approximately 3,690 acres of the conservationists' proposed wilderness area adjacent to the Castle Peak WSA were reviewed in 1997-98 and found to meet the size and roadless criteria for potential wilderness designation. This review area is presently being evaluated to determine if further inventory of wilderness and other resource values is needed, and whether an RMP amendment process should be initiated to consider protection of potential wilderness values.

3.16 Lands and Realty Actions

Lands and Realty Actions are discussed on pages 3-26 and 3-27 of the FEIS. No further discussion is necessary in this document.

3.17 Transportation

This discussion replaces the Transportation discussion in the FEIS on page 3-27.

Travel within the GSRA and Region 4 is provided by Federal and State highways, County roads, public roads, National Forest roads and BLM-administered roads. Many of the public lands administered by the BLM are accessible to the public by one or more of these kinds of roads.

Map 3.17-1 shows the existing transportation system featuring roads within Region 4. The current road inventory indicates about 83 miles of Interstate highway, 38 miles of State highway, 303 miles of County roads including about 289 miles within Garfield County, 178 miles of National Forest system roads, and 423 miles of roads administered by BLM. There are also about 34 miles of BLM non-motorized trails within Region 4.

BLM annually maintains an average of 75 miles of roads accessible to the public within the GSRA with an increase of 25-50 miles expected for roads within the recently-acquired Naval Oil Shale Reserves. Of the 75 mile total for the resource area, about 25 miles are maintained within Region 4. Oil and gas operators are responsible for periodic maintenance of BLM roads used for their operations.

An assessment was conducted and found that 57 miles of roads have been specifically constructed for oil and gas development on public lands. About 60 percent of the 57 miles were build on public lands and the remaining 23 miles were constructed on private lands including split estate holdings.

3.18 Social and Economic

The area most likely to have socioeconomic impacts from oil and gas development in the GSRA includes Mesa and Garfield Counties. Virtually all of the drilling and production would occur in central Garfield County, and most of the employment will be coming from Garfield County.

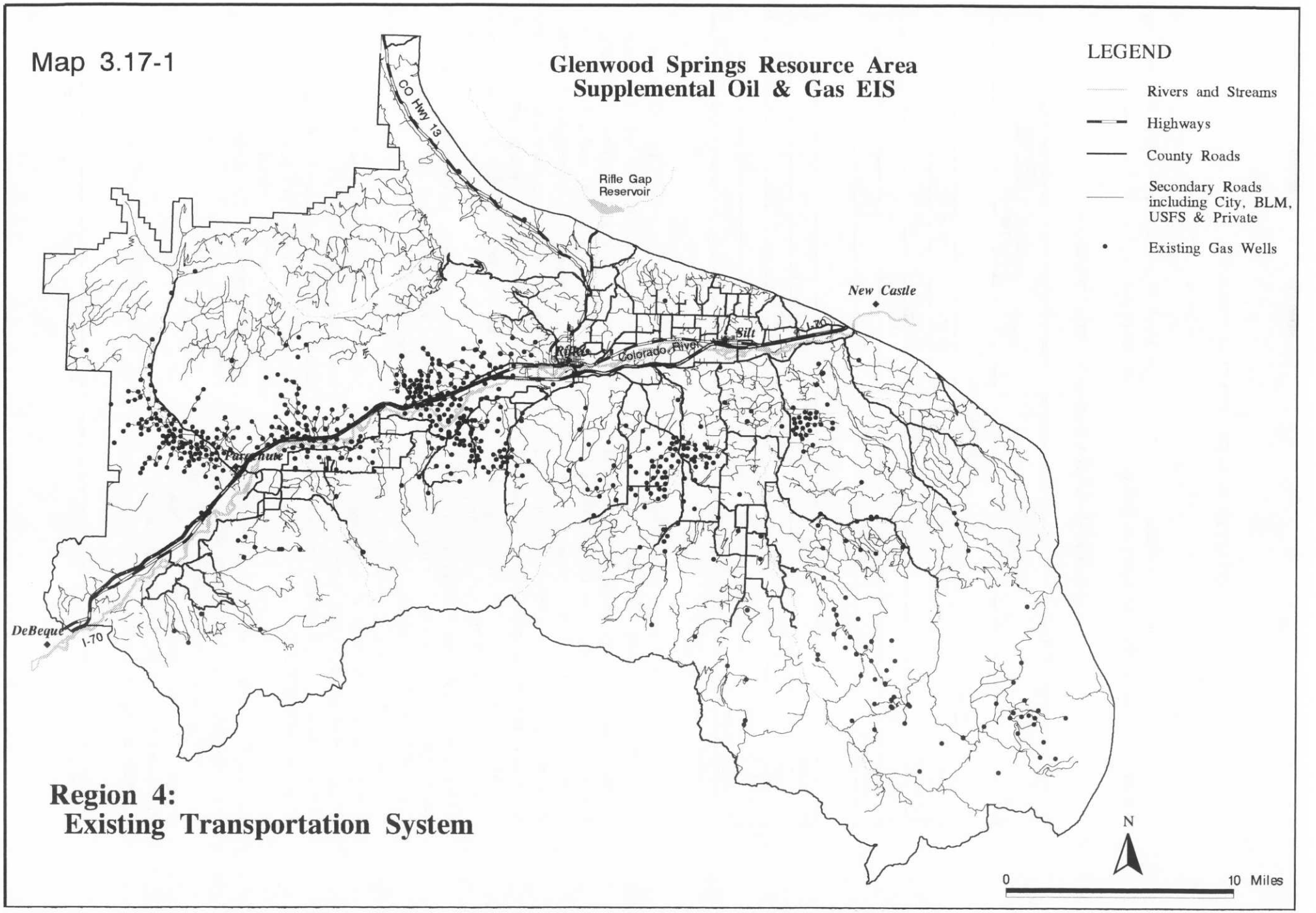
Table 3.18-1 describes the socioeconomic indicators for Garfield and Mesa County. The changes that the occurred between 1982 and 1987 are the result of a reduced demand for energy fuel production because of a downturn in prices. The change from 1987 to 1995 reflects a broad-based improvement in the counties' economies and not a return to high level of mining employment.

In 1985, mining employment was 725 in Garfield County while in 1995 it was only 171. For the same period, mining employment in Mesa County was 1,183 in 1985 and dropped to 608 by 1995. While employment and income related to the oil and gas industry cannot be calculated with any exactness at the county level, it is possible to estimate those figures. A 1981 survey (McKean, Weber, and Ericson 1981) indicated that about 5.5 percent of Mesa County's employment was directly or indirectly tied to the oil and gas industry. Assuming that ratio is still good, approximately 3,199 Mesa County jobs are today tied to the industry. Both the percentage and the total for Garfield County are much lower.

A recent survey of oil and gas operators in Region 4 indicated that the operators and their primary contractors in recent years have required about 160 employees for construction, drilling, completion and overhead work performed in Region 4 (Moore, 1998). Depending on the particular activity, 30 to 90 percent of the employees live in Garfield

Map 3.17-1

Glenwood Springs Resource Area
Supplemental Oil & Gas EIS



Region 4:
Existing Transportation System

County; the rest live primarily in Mesa County. Assuming an annual average salary of $40,000, this level of employment would represent an annual payroll of about $6.5 million.

Table 3.18-1 GSRA Socioeconomic Indicators

	1982	1987	1995	% Change	
				1982-87	1987-95
Garfield County					
Population	28,751	25,655	29,974	-10.8%	16.8%
Employment	17,031	14,893	19,559	-12.6%	31.3%
County Revenue *	13.4	11.9	15.4	-11.2%	29.4%
Personal Income*	376.0	365.4	468.4	-2.8%	28.2%
Mesa County					
Population	94,075	86,498	93,145	-8.1%	7.7%
Employment	49,186	43,515	58,166	-11.5%	33.7%
County Revenue*	N/A	N/A	60.7		
Personal Income	1,063.2	1,126.3	1,234.3	5.9%	9.6%

**Millions of dollars*

Gas production in Region 4 in 1996 was 36,254,760 mcf from an estimated 545 producing wells. Oil and gas sales volume from federal wells in Fiscal Year 1997 in Garfield County was $7,860,998. This yielded a royalty value of $3,408,991 to the Federal Government, based on a royalty payment of 12.5 percent of the value of production. Of the total federal royalty, 50 percent, $1,704,503, was disbursed to the State of Colorado. In 1997, Garfield Country received $319,000 of the federal revenues returned to the state. The school district received $100,000 and the cities and towns in Garfield County received $131,000. (See Appendix K for an explanation of the way in which federal mineral receipts are disbursed with in Colorado.) Oil and gas sales volume for Fiscal Year 1997 in Mesa County was $2,336,783 which yielded a royalty value of $1,011,983, half of which, $505,996, was disbursed to the State of Colorado. Of the money disbursed to State of Colorado, Mesa County received $215,000 with the School District receiving $81,000 and the cities and towns receiving $28,000.

The 1997 severance tax direct distribution is based on distributing 15 per cent of the revenues in the local government Severance Tax Fund to counties or municipalities on the basis of residence of severance taxpayer employees as reported to the Department of Revenue by severance taxpayers. Jurisdictions in Garfield County had 21 oil and gas employees and received $29,405.

Since 1994, jurisdictions within Garfield County have also received about $2.7 million in three separate grants from the Local Government Mineral Impact Fund. this fund is made up of portions of Colorado's federal mineral receipts and state severance tax collections (Colby, 1998).

3.19 Areas of Critical Environmental Concern

Areas of Critical Environmental Concern (ACEC) are discussed in the FEIS on page 3-32. Any additional information on such areas in the GSRA is included in Sections 3.11, Recreation and 3.12, Visual Resources.

3.20 Minerals

This section supplements the discussion of Mineral Resources in the FEIS on pages 3-32 through 3-36.

3.20.1 Oil and Gas

Geology. Region 4 lies within the Piceance Basin. The Piceance Basin is bounded on the north by the Axial Basin Uplift, on the east by the White River Uplift, and on the south by the San Juan volcanics and Uncompahgre Uplift. It is separated from the Uinta Basin to the west by the Douglas Creek Arch. The Piceance Basin is highly asymmetrical with a gently dipping western flank and a steeply dipping eastern flank, known as the Grand Hogback Monocline.

Within Region 4, natural gas has been developed from two formations; the Wasatch and the Mesaverde Group. The Wasatch Formation is a thick sequence of variegated shales and fluvial sandstones that represents a mixture of fluvial, alluvial and piedmont deposits. Wasatch well depths vary from 1,500 feet to 3,000 feet. Very little Wasatch development has occurred in recent years.

The Mesaverde Group is divided into the deposits of the Iles Formation (includes Rollins, Corcoran, and Cozzette sandstone members) and the overlying massively stacked, lenticular nonmarine Williams Fork Formation (including the Cameo Coals). Early Mesaverde development within Region 4 was primarily in the Cozzette and Corcoran sandstones. The primary development over the past several years has been from the Williams Fork Formation. The Williams Fork Formation is a 1500 to 4000 foot thick package of tight sands, shales and coals. The sands are point bar deposits stacked into a composite of meander-belt reservoirs each 20 to 60 feet thick and about 1500 feet wide, with considerable internal discontinuity and compartmentalization. Williams Fork wells vary in depth from around 5000 feet to 10,000 feet with the shallower wells being in the Hunter Mesa area and the deeper wells being in the Flatiron Mesa area. The increase in Williams Fork development in recent years, has been a result of agressive development of the total stack of lenticular sands intersected by a wellbore. This approach included completing the well in multiple zones, increasing the size of the proppant load used in hydraulic fracturing, and using sophisticated fracturing fluids and procedures.

Leasing. In accordance with the 1920 Mineral Leasing Act, and subsequent amendments, BLM holds quarterly lease sales of the oil and gas mineral estate. These quarterly lease sales are for all BLM resource areas within Colorado. Since 1992, new leases offered in the GSRA have been limited, about one a year, because most of the prospectively promising oil and gas area, referred to in this document as Region 4, is already leased. Prior to the acquisition of the NOSR, BLM managed 151,045 acres of BLM surface and mineral estate in Region 4. Almost 95 percent, 143,068 acres, is held in 379 oil and gas leases, the majority issued prior to 1991.

Although the primary term of a lease expires after a ten year period, leases are extended indefinetly so long as they remain capable of producing oil or gas in paying quantities. These leases are considered to be held by production. Most of the leases in Region 4 are held by production and can be expected to continue to

be held into the future. Unleased parcels, or parcels occasionally terminating from an undeveloped lease within Region 4, are generally requested by industry for new lease issuance.

The transfer of the NOSR from DOE to BLM increased the mineral estate managed by the GSRA by 49,892 acres. None of this land has ever been leased; during the fall of 1998, portions of the 11,590 acre NOSR Production Area will be offered for lease on terms developed in this plan amendment process. The remaining 38,302 acres will be offered for lease in the future, after an additional planning process.

Leases are issued with the right to fully explore and develop the mineral resource, with all the attendant surface disturbance and resource impacts, consistent with the terms and conditions of the lease, laws and regulations. Leases issued up to 1976 had few conditions for environmental protection. Those issued after 1976, contained what are referred to as the Standard Terms and Conditions. The most frequently cited term is *Section 6, Conduct of Operations*, which requires that operations be conducted so as to minimize "adverse impacts to the land, air, and water, to cultural, biological, visual, and other resources, and to other land uses or users." Leases issued after the completion of the GSRA Resource Management Plan (RMP) in 1984, were issued with Standard Terms and Conditions and with additional environmental stipulations developed as part of the RMP. Leases issued after the FEIS in 1991, held the Standard Terms and Conditions and the new stipulations developed in the FEIS. Appendix B contains a more extensive description of the leasing process and lease rights and Appendix D contains the Standard Terms and Conditions.

Drilling Activity. Refer to Section 4.20.1, Minerals, Impacts to Date, for a discussion of drilling activity on public mineral estate in region 4.

For all of the 117 producing gas wells, 48 (41 percent) are on private surface with federal minerals.

Chapter Four

ENVIRONMENTAL CONSEQUENCES

4.1 Introduction

Chapter 4 of the Colorado Oil and Gas FEIS described the Environmental Consequences of the alternatives considered in that document. Those portions of that original evaluation that remain accurate and sufficient are not repeated here. Those portions that require replacement, modification or more extensive information are included in this chapter. Each section of this chapter references its counterpart in the original document and notes whether it replaces, modifies or supplements the description in the original FEIS.

As discussed in Chapter 1, the focus of this supplemental EIS is on Region 4 of the GSRA, the area of highest potential for oil and gas development. Within Region 4, the Production Area of the recently acquired NOSR receives additional attention, as it was not included in the original EIS. That part of the NOSR north of the Production Area is not formally included in the analysis but may be mentioned. The remainder of the GSRA will be referenced occasionally as needed.

This analysis of environmental impacts differs from those found in other EISs in that it includes an evaluation of impacts that have occurred as a result of oil and gas development to date. Ordinarily, impacts that have already occurred would have become part of the affected environment and would have been considered in that portion of the document. However, in this case, it was determined that the reviewer would be better served by including the evaluation of impacts that have already occurred with the evaluation of those that may occur in the future under each alternative. In this way, impacts to date can be described in light of the same conditions and impactors that future impacts would be described. In addition, the analysis of past impacts determines to a great extent how future impacts are evaluated. For example, the average per well surface disturbance to date is the best guide to disturbance that wells in the same area would generate in the future.

Three alternative courses of management action are analyzed here - the Continuation of Current Management Alternative, the Maximum Protection Alternative and the Proposed Action. The alternatives are described more fully in Chapter 2 and in Appendices F,G and H. The difference between each of the alternatives is the combination of mitigation measures that BLM would apply to oil and gas leasing and development in the GSRA. The primary component of the mitigation strategy in each case is the lease stipulations that would apply to new leases. As described in Chapter 2 and Appendix B, stipulations cannot be applied retroactively to a lease and most of the focus area, Region 4, is already under lease. The major exception, of course, is the NOSR Production Area, which will be offered for lease for the first time at the completion of this supplemental EIS process. While not legally binding on many of the leaseholds, stipulations do, however, provide the public and the operators with a clear expression of BLM's management intent. The GSRA will attempt to achieve the objectives by Conditions of Approval, offsite mitigation or other measures that do not diminish the lease right originally granted.

This situation makes the job of the environmental analyst complicated. The effect of a legally binding stipulation in an area that is not leased, like the Production Area, is simpler to describe than the effect of a stipulation that serves as a management guide. In the discussion of impacts, the distinction is noted frequently.

4.2 Climate and Air Quality

Climate. No significant, adverse impacts to climate are anticipated from implementation of the Proposed Action or Alternatives.

Air Quality. No significant, adverse impacts to air quality are anticipated from implementation of the Proposed Action or Alternatives. Based on recent analyses of similar proposed natural gas development in the Rock Springs District of Wyoming (BLM 1998), localized short-term increases in particulate matter, carbon monoxide, nitrogen dioxide, and ozone concentrations would occur, but maximum concentrations would be well below applicable ambient air quality standards. Similarly, hazardous air pollutant concentrations would be well below the states' Acceptable Ambient Concentration Levels, and the related short- and long-term cancer risks (to well rig operators and nearby residences) would be below significance levels.

Construction emissions would occur during road and wellpad construction, well drilling, and well testing. Particulate matter emissions would be minimized by application of water and/or chemical dust suppressants. During well completion, natural gas would be flared (burned off), which could increase both the level and aerial extent of noticeable odors for up to ten days. However, since the burned natural gas does not contain sulfur compounds and ambient concentrations would be below applicable air quality standards, potential odors would not have a significant adverse impact.

It is assumed that, at a maximum, one million cubic feet of gas per day would be burned in a pit flare at each well up to a maximum period of ten days. At the proposed level of well field development, seldom more than four wells throughout the project area, and rarely more than two wells in close proximity, would be flared at any one time. Based on these assumptions, completion testing at each well would emit up to a total of 1.85 tons of carbon monoxide (CO), 0.34 tons of oxides of nitrogen (NOx), and 0.031 tons particulate matter (PM_{10}). Given the temporary nature and low levels of potential emissions, State of Colorado air pollutant emission permits would not be required. In this situation, air pollutant emissions notices are only necessary for sources greater than 2.0 tons per year (CO and NOx), and permits are not required for sources with potential emissions under 10.0 tons per year.

Operation emissions would occur from increased compression requirements and fugitive well gas emissions. It is anticipated field-wide compression would increase from approximately 12,000 hp to 32,000 hp (at six existing compressor locations), and that four per cent of the proposed wells would require installation of Best Available Control Technology (combustion controls) to minimize fugitive volatile organic compound emissions.

Given the extent of the potential air pollutant emissions and the distance to nearby PSD Class I Wilderness Areas, no significant, adverse impacts to "Air Quality Related Values" (primarily visibility and atmospheric deposition) are anticipated.

It is important to note that before development could occur, the Colorado Department of Public Health and Environment, Air Pollution Control Division (CDPHE-APCD) would review all applicable, project-specific air pollutant emissions preconstruction permits which examine potential project-wide air quality impacts above statutory minimum levels. Thus, as development occurs, additional site-specific air quality analyses would be performed to ensure protection of air quality resources.

4.3 Vegetation

4.3.1 Riparian and Wetlands

Development in or near the riparian area has detrimental impacts on the riparian habitat. Throughout the resource area, the functions and values of riparian habitat have been severely impacted by road construction, cultivation, water diversions, impoundments, gravel extraction,

livestock grazing and construction of gas wellpads and facilities.

Riparian impacts can be described in terms of direct and indirect impacts. Direct impacts include removal of riparian vegetation, physical loss of wildlife habitat, increased sedimentation from surface disturbance or bank erosion, and changes in channel morphology. Indirect impacts include a decline in macroinvertebrates, fish and amphibians due to siltation of gravel beds and spawning areas and reduction in the usability of riparian habitat as wildlife is displaced due to human activity.

Stream crossings or disturbances that encroach upon the riparian vegetation itself may adversely affect the physical functioning of the stream. Stream hydrology may be altered, bank erosion may increase, additional sediment may enter the channel creating impacts to the aquatic habitat and water quality downstream. Riparian vegetation is lost and this decreases the ability of the riparian area to trap sediment and nutrients, to moderate floods, and to provide shade for terrestrial and aquatic wildlife.

Surface disturbances adjacent to the riparian area may also adversely affect the physical functioning of the riparian area primarily due to increased runoff and sediments entering the riparian area. The amount of increased runoff is proportional to the amount of soil and vegetation disturbed and the degree of slope. Loss of ground cover decreases infiltration of water and increases surface runoff. Severe loss of ground cover may result in the formation of pedestals, rills and gullies that greatly concentrate runoff, increase peak flows, and damage streams. Increased runoff is greatest where ground cover is removed and soils are compacted, as with roads and pads. (Maxwell, CRA, 1995).

Impacts to localized aquatic habitat would result from increased sedimentation. Sediment would cover gravel beds on the stream bottom resulting in loss of habitat for macroinvertebrates which serve as the primary food source for most fish species. In addition, gravel beds serve as spawning areas and are necessary for successful reproduction by many fish species.

The adjacent uplands are valuable to wildlife because they provide additional forage in close proximity to nesting and hiding cover. Research indicates that the habitat adjacent to and in close proximity to riparian areas is also important nesting habitat for ground-nesting birds and other species. Since predators often follow the riparian corridor in search of prey, birds and small mammals tend to move into the immediately adjacent habitat for nesting and raising of young (Broderick, pers. comm).

The influence of human activities along roads and wellpads has an indirect impact beyond the physical extent of the development. Even though riparian habitat may not be physically lost or altered, the usability of the habitat for wildlife may be diminished. Wildlife exposed to increased human activity, equipment operation, vehicle traffic and noise often avoid or move away from these types of disturbances to other habitat areas. This avoidance is referred to as displacement and would result in underuse of habitat near the disturbance. This displacement reduces habitat usability and the capacity of affected acreages to support wildlife.

The distance wildlife would move to avoid the activity varies by wildlife species, topography and the degree of vegetative cover, as well as the time of year and the amount and type of traffic. Fish and amphibians might only be affected by activities within five to six meters beyond the extent of actual physical disturbance. Songbirds might be affected by activities within 75 to 100 meters. Species which are more sensitive to human disturbance, such as mountain lion and black bear, might be affected by activities within 800 meters, whereas more adaptable species like mule deer may only be affected by activities within 200 meters.

Displacement is most severe during the construction phase of the oil and gas activity, but the effect may also continue to a lesser extent for the life of the well pad due to human activity

associated with regular visits to the well pads. This is especially true during critical times of the year such as during nesting/production(birthing) and rearing of young. Average use of habitat is expected to increase gradually with distance from roads and facilities.

For the purpose of this analysis, an impact zone of 152 meters (500 feet) on either side of the development was selected. Thus a road 500 feet away which might disturb nesting birds due to occasional vehicle traffic would be considered an impact as well as a road 30 feet away which may increase sediment entering the stream, affecting water quality and fish habitat.

See Section 3.5, Wildlife, for additional discussion of displacement impacts.

4.3.1 Impacts To Date

BLM Impacts to Date. As of late 1997, there were 160 oil and gas wells on BLM-managed lands. As shown on Table 4.3-1, these 160 wells have adversely affected 101 acres of riparian areas on BLM and private surface. (This analysis attributes the impacts of a road to a gas well on BLM-administered mineral estate that crosses private property to the BLM development.) In addition to the indirect impact of roads, 20 stream crossings are attributable to development of BLM oil and gas resources. Each stream crossing causes a direct loss of riparian vegetation, and increase in stream sedimentation and the disruption of habitat function and value.

Table 4.3-1 Riparian Acreages and Impacts by Land Ownership

STATUS	Total Riparian		Riparian Affected by All Roads			Riparian Affected by BLM O&G Roads		
	Acres	%	Acres	% Land by status	% Total Affected Acres	Acres	% Land by status	% Total Affected Acres
BLM	182	5.2	95	52.2	6.6	16	8.8	15.8
NOSR	126	3.6	47	37.3	3.2	0		
NOSR Production Area	10	0.3	6	60.0	0.4	4	40.0	4.0
Split Estate	113	3.2	87	174.0	6.0	7	7.0	6.9
Total BLM	**431**	**12.2**	**235**	**54.5**	**16.2**	**27**	**6.3**	**26.7**
FOREST	196	5.6	91	46.4	6.3	2	1.0	2.0
Total Federal	**627**	**17.8**	**326**	**52.0**	**22.5**	**29**	**4.6**	**28.7**
State	31	0.9	26	83.9	1.8	0		
Private	2867	81.3	1098	38.3	75.7	72	2.5	71.3
Grand total	**3525**	**100.0**	**1450**	**41.1**	**100.0**	**101**	**2.9**	**100.0**

On BLM-managed lands, 54.5 percent of the riparian areas have been affected by all variety of impactors. Less than 200 acres of riparian areas on public lands have not been directly or indirectly affected by human development. (Table 4.3-1). The largest remaining tracts of unaffected riparian areas on BLM managed land are found on:

- the East Fork and East Middle Fork of Parachute Creek on the Roan Cliffs;
- small tracts of public land along the Colorado River;
- Dry Creek;
- the upper reaches of tributary streams to the main Parachute Creek; and

- the upper end of Hayes Gulch and Cottonwood Gulch.

This list does not include all the remaining unaffected riparian areas, only the largest tracts. However, these are the largest contiguous parcels, in many cases the upper portions of watersheds which are currently unroaded, and they each contain late-seral riparian vegetative communities, consisting of mature cottonwoods, willows, and various herbaceous species. The diversity of vegetation and community structure provides some of the most important wildlife habitat in the Region. These late-seral riparian areas are generally more important wildlife habitat than the early-seral sedges and rushes or thin isolated patches of willows, because of the greater diversity of habitat niches available. The cottonwoods provide valuable nesting sites for raptors, willows provide nesting habitat for numerous non-game birds, and the willows and cottonwoods provide shade for terrestrial and aquatic wildlife as well as visual screening of human activities.

Another riparian area which is shown on the map as largely unaffected by development is upper Porcupine Creek. However, Porcupine Creek is in a naturally highly erosive watershed. A tremendous amount of rock and debris is transported in the stream channel, which has created steep, raw stream banks and very little riparian vegetation. The riparian values of this stream are not considered a high priority for protection. However, surface disturbance in the proximity of the drainage should be strictly controlled because the lack of riparian vegetation to filter incoming sediment increases the possibility that offsite sedimentation will enter the stream channel.

Other riparian areas which are indicated on the map as "impacted" by roads or pads may not be severely impacted yet. Some of the roads included in the analysis are very rough two-track trails which are used only infrequently for grazing administration and hunting access. As long as the access remains unchanged, these streams will retain most of their riparian values. Examples of these streams would include: Wallace Creek, and the lower part of Dry Creek.

Cumulative Impacts to Date. Since data on oil and gas roads on private land are limited, the effect of those roads is extrapolated from the data on BLM oil and gas development. The assumption is that impacts on private land are similar in nature and extent to impacts on public land. If 160 wells on federal mineral estate contributed to 101 acres of riparian impact, then the total of 700 wells drilled in region 4 has impacted 442 acres. This represents the acres of riparian impacted by all oil and gas roads and wellpads. Four-hundred forty-two acres represents 12.5 percent of the total riparian vegetation in Region 4. In fact, the riparian acreage affected by oil and gas activity on private land could be proportionately greater since there is proportionately more riparian on private lands. (Private lands encompass more riparian areas and therefore roads and wellpads on private land are more likely to impact riparian than on public land which has fewer riparian acres.)

There are an estimated 645 stream crossings in all of Region 4, 20 attributable to development of oil and gas resources on federal mineral estate. Each stream crossing causes a direct loss of riparian vegetation, an increase in stream sedimentation and the disruption of habitat function and value.

Oil and gas activities have probably caused little impact to riparian areas in Region 4 when compared to other types of human disturbance. For instance, the construction of I-70 and the D&RGW railroad has narrowed the riparian zone along the Colorado River floodplain. In addition, many agricultural practices and housing developments have affected riparian areas. An estimated total of 1,450 acres of riparian habitat have been directly or indirectly affected by all roads through 1997. This means 41.1 percent of the riparian areas in Region 4 have reduced effectiveness because of the proximity of roads.

These figures probably underestimate the total impact on the riparian zone because we do not have complete data for all the impacts occurring on private land, such as housing development, agricultural and commercial development, road and railroad construction, and oil and gas

activities. It is likely that in total, more than 50 percent of all the riparian areas in Region 4 have already been lost or their function and values diminished. Although oil and gas development represents only a small portion of this total habitat loss or impairment, it is an impact which can be avoided or mitigated to minimize further loss of riparian values.

The largest remaining tracts of unaffected riparian areas on non-BLM land include:

- the Colorado River between Debeque and Parachute;
- islands in the Colorado River;
- upper Battlement Creek; and
- the USFS creeks on Battlement Mesa.

4.3.2 Future Impacts

4.3.2.1 Continuation of Current Management

The 1991 FEIS created a Controlled Surface Use (CSU) stipulation to protect a one-half mile buffer around major river corridors and to confine surface disturbance on smaller streams and bodies of water beyond the extent of the riparian vegetation. Under the Continuation of Current Management Alternative, this CSU would be applied to any new leases but its application to existing leases would be voluntary. (FEIS, p.4-4)

For streams other than the major rivers, this stipulation provides only for the avoidance of the actual riparian vegetation itself. This does not take into account the effects of a road or pad immediately adjacent to a riparian zone. Depending on the width of the riparian area, the type of vegetation and the surrounding topography, disturbance within 500 feet of the riparian area may diminish the usability of the habitat or cause increased sedimentation and siltation of the stream itself. If the surrounding slopes are steep or the soils erosive, and if the riparian vegetation is not wide enough to filter all the incoming sediments, the excess erosion may enter the stream channel and cause a degradation in water quality.

As described in 4.1, Introduction, most BLM oil and gas leases in effect in Region 4 operate under Standard Terms and Conditions rather than the stipulations determined in the FEIS because they were issued prior to the completion of the FEIS. Mitigation applied to development activities on active leases must be consistent with lease rights granted unless the lessee or operator voluntarily incorporates such measures. However, the GSRA has attempted to work within the constraints of the old leases to mitigate impacts and to encourage voluntary mitigation where possible. Post-lease COAs have been used to reduce the loss of riparian habitat values.

Some of the efforts to date have included: minimizing overall wellpad size as much as possible, rounding pad corners to avoid placing fill material in an adjacent drainage, placing pipelines in the road right-of-way, moving wellpads and roads to the flattest terrain possible, while trying to avoid placing those facilities in the riparian zone, and developing a reclamation policy to clearly articulate our standards for reclamation.

Existing leases do not include any special stipulations for the protection of riparian zones. The Standard Terms and Conditions allow relocation of the pad up to 200 meters, however, due to the frequent juxtaposition of steep slopes and riparian areas in Region 4, relocating proposed gas wells and roads may often lead to a tradeoff between constructing in a riparian zone or building on steep slopes.

In the past, this tradeoff has often led to management decisions to place the disturbance in or within 100 feet of the riparian zone. Past development has generally occurred on the less challenging sites. As development proceeds and well density increases, proposed sites may become more challenging in the future. New proposed sites may encroach further upstream into steep, previously undisturbed canyons. On the other hand, as the density increases, there is

the likelihood that less riparian impacts will occur in the future because in many cases the road infrastructure is already in place and new pads can be accessed without additional stream crossings and without building new roads and pads in the vicinity of riparian areas. Also as density increases, industry may voluntarily choose to collocate some pads and employ directional drilling to extract the resource.

Hence, it is reasonable to assume that, without further lease stipulations, approximately the same proportion of future locations will be built in riparian areas. Assuming the same proportion, we can estimate the amount of riparian acreage that will be impacted for the life of the plan at about 189 acres, an additional five percent of riparian habitat, bringing the total acreage directly affected by development on federal mineral estate to about eight percent.

4.3.2.2 Maximum Protection Alternative

The primary difference between the Maximum Protection Alternative and the Continuation of Current Management is in the environmental constraints which would apply to any new leases. See Appendix F for the lease stipulations that would apply under the Maximum Protection Alternative.

The Maximum Protection Alternative protects riparian values on new leases with a No Surface Occupancy (NSO) stipulation within 500 feet of riparian areas. Since most of Region 4 is already leased, the only areas where this stipulation would legally apply is on new leases, such as those in the NOSR Production Area. This area contains only two sizeable riparian areas, one in Hayes Gulch and the other in Cottonwood Gulch. Application of this stipulation would provide more protection for these riparian areas, but would have limited impact on overall oil and gas development.

With the exception criteria identified, there will continue to be some surface disturbance within 500 feet of riparian areas and even some additional loss of riparian vegetation. Although additional stream crossings may occur, the incremental increase should be minimal with the application of appropriate mitigation, which should be developed in the context of a Plan of Development to address transportation and infrastructure. The stipulations included under this alternative give BLM authority to protect the highest value riparian areas and to mitigate most of the adverse impacts on all riparian areas.

On existing leases, compliance with the new stipulations would be voluntary. Riparian areas may be protected to a lesser degree with the use of the Standard Terms and Conditions which allow a move of up to 200 meters to protect resource values. In addition, COAs may be attached to the Permits to Drill to mitigate impacts as long as they do not interfere with the rights granted under the lease. The COAs identified to protect riparian areas are: 1) Stream crossings will be kept to the absolute minimum and will be located where riparian values are the lowest, 2) Replanting of native riparian vegetation may be required, and 3) Installation of sediment traps may be required to protect water quality.

Mitigation efforts could be improved by requesting the oil and gas development companies to submit a Plan of Development prior to constructing multiple wells in a concentrated area. This would allow us to design a transportation system and optimum well locations for a whole series of wells to minimize adverse resource impacts. The piecemeal approach of addressing impacts on a pad by pad basis may not actually minimize the number of well pads and the amount of new road construction required.

Design future development to limit the number of riparian crossings. Where crossings are unavoidable, design crossings to minimize extent and value of riparian vegetation disturbed; design culverts so they do not obstruct stream flow or change stream gradient.

If large areas of riparian vegetation are disturbed, effective mitigation may require replanting with native riparian species appropriate for the site. This may include planting willow plugs, cottonwood poles, and clumps of herbaceous riparian species.

4.3.3 Proposed Action

The Proposed Action lease stipulations that would apply to new leases are found in Appendix F. The differences between the Proposed Action and the Maximum Protection Alternative are that the Proposed Action provides for No Surface Occupancy (NSO) on the riparian vegetation zone only. The adjacent habitat (a 500 foot buffer) is protected by Controlled Surface Use (CSU). Exceptions to the NSO may be granted for stream crossings or for other activities if the Authorized Officer (AO) determines that any riparian vegetation lost can be replaced within 3-5 years.

This alternative provides less protection for riparian habitat than the Maximum Protection Alternative. A higher percentage of riparian values will be lost because of facilities that may be sited within this zone. However, under this alternative, the AO has the authority to protect the highest value riparian areas and to minimize impacts to other riparian areas.

These stipulations will only apply to new leases, such as those granted in the NOSR Production Area. Applying these stipulations to the limited riparian resources in the NOSR Production Area, should protect the riparian values while having minimal impact on oil and gas development.

On existing leases, compliance with the new stipulations would be voluntary. As discussed in the Maximum Protection Alternative, riparian areas may be protected to a lesser degree with the use of the Standard Terms and Conditions and by adding certain COAs to Permits to Drill. These Conditions of Approval may include: 1) Minimizing the number of stream crossings and locating those crossings where riparian values are the lowest, 2) Replanting native riparian vegetation to restore site function, and 3) Installing sediment traps to protect water quality.

Although total impacts are expected to be greater than under the Maximum Protection Alternative, overall impacts are still thought to be small. There would be some unavoidable loss of important riparian habitat in localized areas.

4.4 Livestock Grazing

The Livestock Grazing portion of the Environmental Consequences section was discussed on pages 4-2 and 4-3 of the FEIS. A preliminary evaluation of the impacts of oil and gas development on livestock grazing since the publication of the FEIS indicated that no additional discussion was necessary.

4.5 Wildlife

4.5.1 Introduction

Some of the impacts expected to occur from gas development in the GSRA are discussed on pages 4-3 through 4-10 of the FEIS. This SEIS focuses on Region 4, which contains most of the gas development activity expected to occur in the GSRA. The discussion in this section is supplemented in many instances by more detailed information found in Appendix G.

Currently, most of the gas development in Region 4 has been concentrated in the central portion, an area encompassing 183,012 acres, with some scattered development outside this area. See the well locations displayed on Map 1-2. Assuming the current rate and location of development will continue, 92 percent of the future gas development activities would be clustered within this area. To date, 160 of the 700 wells drilled in Region 4 have been drilled

on BLM-managed minerals. This analysis assumes an additional 300 wells on public mineral estate in the next 20 years, 1,200 wells overall.

Wildlife are affected differently during each phase of gas development - construction, operation and abandonment. The ***construction*** phase includes preconstruction permitting and siting of facilities; construction of wellpads, pipelines, electrical utilities, produced water disposal facilities, and compressor stations; construction or improvement of access roads; and drilling and completion of gas wells. These activities require numerous personnel and equipment. They typically occur at each well over a period of 25-40 days. Reclamation on about 50 percent of the area disturbed by construction would begin immediately. The remainder of the area disturbed would be occupied by aboveground facilities for the life of the project. Successful reclamation for weed and erosion control is expected to occur within 3-5 years after disturbance; however, restoring to productive wildlife habitat could take up to 20 years.

Gas production, treatment, collection, compression, and produced water disposal take place during the period of ***operations***. These typically involve minimal personnel in the field except at compressor stations and water disposal facilities and traffic to each well for monitoring and maintenance. Although human activity is less than during construction (except during "workover" periods), it continues throughout the year. The activities having the greatest effect on certain species of wildlife occur during the winter, associated with regular visits to the well pads for facility maintenance, daily monitoring, produced water removal, road maintenance and snow removal, and increased use of the area by the public. Impacts result from vehicle use, the presence of humans and dogs (game animals are immediately stressed, once a human or dog form can be distinguished from a vehicle, regardless of whether there is an attempt to harass) and illegal hunting. Occasional recompletion efforts have an effect similar to that of construction.

Abandonment occurs at the end of a well's productive life, thought to be 20-30 years in Region 4; there are, however, currently producing wells in the 40-50 year age range. At the end of the operational life of each well, facilities are removed, wells are plugged and access roads reclaimed, unless the roads are deemed necessary for resource management or if requested by the landowner. These activities involve a short-term increase in people and vehicles in the project areas. Abandonment and reclamation activities require approximately three days per well and four days per mile of access road, for a crew of four people.

4.5.2 Direct and Indirect Impacts

The following general discussion of the direct and indirect impacts of gas development in Region 4 on big game, raptors, and other species of concern, is intended to lay the foundation for the discussion of impacts for the Proposed Action and alternatives. Development on BLM-managed minerals has only a small direct effect on all habitats, generated primarily by the surface disturbance required for wellpads, roads and pipelines. However, construction and operation disturbances emanating from these areas reduce habitat effectiveness for wildlife in a much larger surrounding area. These disturbance zones vary in width depending on a number of factors, including intervening terrain and vegetation, the type and duration of the disturbance, the species of wildlife present, and the time of year.

Big Game

Big game species in Region 4 include mule deer, elk, bighorn sheep, black bear and mountain lion. Direct and indirect effects on these species could occur during each project phase, but the magnitude of effects would vary depending on the type of activities, the species affected, and the seasonal sensitivity of the

species and its habitat. Elk and mule deer are the big game most adversely affected by the development in Region 4 under all alternatives. Adverse effects are primarily associated with disturbances on, and displacement from winter ranges. In the area of concentrated development, approximately 85 percent is classified as mule deer winter range, 50 percent as mule deer severe winter range, 50 percent elk winter range and 25 percent elk severe winter range.

Mountain lion are sensitive to disturbance, but are more likely to be affected by their link to their prey base. Mountain lion tend to follow mule deer and elk herds as these two species are the primary source of food; thus as deer and elk populations move or decline, so do mountain lion populations. The mountain lion population base is much smaller and it takes longer to recover from a decline.

Black bear are wide-ranging, long-lived and reproduce at a late age. They are sensitive to overharvest, human disturbance and illegal harvest, which are all related to increased road density and access. They recover from population declines very slowly. They are more habitat specific and have a smaller population size than other big game species. Black bear will be relatively unaffected except in their fall feeding areas if road densities should increase there. Any activity that provides an attraction to food or garbage could adversely affect bears.

Bighorn sheep will only be minimally impacted as most gas development will be located outside of their seasonal ranges and they will receive no further discussion.

Direct Impacts. During ***the construction phase***, the most important direct impact is the habitat loss resulting from construction of facilities (wellpads, roads, pipelines, compressor stations and storage yards). About 50 percent of the disturbed area should be reclaimed within a 3-5 year period; however, revegetation sufficient to return the disturbed area to productive wildlife habitat (proper species composition, diversity, and age) could require up to 20 years. The remaining 50 percent of the affected area would be occupied by the working surface of well pads, roads, and other facilities, and would represent a long-term habitat loss. During the ***operational phase***, the direct impact would continue, unless offset to some extent by enhancement of other habitat. In addition, during "workover" periods, some of the revegetated portions of the pad would be disturbed again. The ***abandonment phase*** would primarily have positive direct impacts by the removal and reclamation of facilities. There would be some habitat loss as the pads and roads are being reclaimed. This is expected to be minimal and relatively short lived.

During ***all phases*** of development, the increased network of roads and associated traffic will increase mortality and injury from big game collisions with vehicles, illegal hunting, legal hunting and harassment from people and dogs.

Direct impacts may be offset to some degree by mitigation efforts that either improve habitat or segregate it from further impacts. A recent example of the former occurred in GMU 42, where an operator purchased 320 acres of deer and elk winter range and implemented habitat improvements in terms of vegetation treatment, riparian fencing and ditch repair and water development. This effort will help to offset the loss of big game winter range due to surface disturbing activities.

Indirect Impacts. The greatest impact on wildlife, especially big game and raptors, is the disturbance caused by increased human activity, including people movement, equipment operation, vehicle traffic, harassment by dogs and noise related to wells and compressor stations. In this case, the physical alteration of habitat is not the issue, but the presence of these activities. Wildlife are relatively secretive, and distance themselves from these types of disturbance or move to entirely different areas sheltered by vegetation screening or topographic

features. This avoidance is referred to as displacement and results in underuse of habitat near the disturbance. Disuse of forage and cover resources adjacent to disturbance reduces habitat utility and the capacity of the affected acreage to support wildlife populations.

Oil and gas road networks are of particular concern as they often remain open to unregulated use throughout the life of the well and beyond. "It is assumed that avoidance-related disuse, in most situations, accounts for up to 50 percent of potential forage and cover use within 300' of a road in heavy cover types, and 600' in open situations. Big game avoidance is considered minor at road densities of 1.5 miles per square mile or less (about 10 percent loss of habitat effectiveness). As road density increases, the influence on habitat effectiveness increases exponentially, such that at road densities of three miles per square mile, habitat effectiveness is reduced by about 30 percent. " (White River Resource Area RMP/EIS). Average road density in the area of concentrated development in Region 4 is currently about 3 miles of road per square mile or greater. Reference Map 4.17-1 for a display of road densities in Region 4 and of the areas where gas development on federal mineral estate has increased road density.

Avoidance is greatest along more heavily traveled secondary or dirt roads (Rost and Bailey 1979, Perry and Overly 1976). Other factors affecting road avoidance by big game include slower traffic speed, vehicles that stop, and traffic with associated out-of-vehicle activity by humans and/or dogs. All of these factors are known to increase the distance big game move away and are typical of traffic associated with gas field activity.

Also associated with displacement is the alteration of migration and natural distribution patterns, resulting in increased or concentrated use of other habitat areas. This is a problem in areas of low quality winter range at or near carrying capacity. It results in overutilization, habitat degradation and increased game damage claims from private landowners. This has been an issue in GMU 42 for several years.

Another important effect of human activity on big game involves additional energy expended through alarm and subsequent avoidance movements. This is particularly critical during periods when energy demand is elevated environmentally (cold/homothermy, snow/ locomotion and forage access) or physiologically (late gestation and lactation). Unnecessary energy expenditures divert energy stored for extended winter nutrition, successful gestation and lactation. This ultimately affects production, survival and recruitment.

Indirect impacts due to displacement would occur during <u>all phases</u>. Wintering mule deer, elk and mountain lion would likely be the most affected since most of the development has and will continue to occur on big game winter range. Drilling typically occurs on a year round basis. The effects from displacement and avoidance movements of big game are greatest on crucial and high value habitat during the critical season.

Under standard lease terms, BLM can restrict gas development for up to 60 days. This restriction is most typically applied in designated crucial mule deer and elk winter range during severe winters (an average of 2 out of 10 winters). There is also some voluntary compliance by operators with a requested 5 month winter restriction for drilling on BLM-managed minerals. However, this appears to simply shift the activity to private lands, so little benefit to big game may be realized.

BLM can control the access on roads associated with development of BLM-managed minerals (about 20-25 percent of total development). Some roads constructed on private lands may be gated and closed to the public, thus limiting most traffic on those privately owned roads to the landowner guests and permitted uses; however, there is still trespass use by individuals who ignore the signs, skirt the gate

or cut the fence and use the area without permission from the land owner.

In some instances, access attributable to gas development can be advantageous in gaining access to BLM lands necessary for achieving big game harvest objectives, project work and fire control.

Indirect Impact Assessment Methodology. The analysis of displacement in this document involved mapping of displacement zones and assessment of the effects on habitat value based on potential levels of human activity. For mule deer, a 1/8 mile displacement from gas pads and roads was used; 1/2 mile was used for elk.(See Appendix G for a discussion of the rationale for the displacement distances.) These represent average displacement distances. Animals may occur within these displacement zones where levels of human activity are low or when sufficient cover is present. Similarly, animals would be displaced at distances greater than the displacement zone where levels of human activity are high and cover is not available. Use of habitat is expected to increase gradually as distance from roads and facilities increases. The zone of reduced use along the roads partially fragments the habitat but would not present a complete barrier to movement of most wildlife species.

To estimate the extent of the displacement effect on mule deer and elk winter range by all activities in Region 4 (I-70, subdivisions, towns, etc.), all roads in BLM's Geographic Information System (GIS) database were buffered, 1/8 mile on either side of the road for deer and 1/2 mile for elk. The resulting buffer represents the area in Region 4 in which roads may influence the use of wildlife habitat. The overlap of these buffer zones with each species' winter range is an estimate of the extent to which their crucial habitat has been affected by all activities in Region 4. Since BLM's road database is not comprehensive, the result may underestimate the impact somewhat. A similar technique was used to estimate the effect of roads on riparian areas.

By this method, the total potential displacement effect of all roads on mule deer winter range was estimated at 151,590 acres. This amounts to 55 percent of the mule deer winter range in Region 4. The portion of this impact attributable to gas development on BLM-administered mineral estate was estimated by comparing the length of roads constructed for BLM wells, 56.8 miles, to the total distance of all roads in the database, 2,098 miles; BLM gas development roads make up about 2.7 percent of the total. Since all BLM wells have been drilled in mule deer winter range, 2.7 percent of the total impacted mule deer winter range is estimated to be attributable to BLM gas development. This amounts to 4,093 acres, averaging 26 acres per BLM well. This average is assumed to apply to future BLM development.

The same method, but using a 1/2 mile buffer on the roads instead of 1/8 mile, estimates that 245,357 acres of elk winter range, 94 percent of the total, has been influenced by all activities. Since only 50 percent of the BLM development has occurred in elk winter range, the potential displacement effect of BLM development, 6,624 acres (2.7 percent of the total affected acreage), is only half that, 3,312 acres, averaging about 21 acres per BLM well. This average is assumed to apply to future BLM development.

The cumulative indirect affect of all oil and gas roads was estimated by assuming that all newly constructed oil and gas roads averaged the same length as new BLM oil and gas roads, .38 of a mile. If so, then the 700 wells drilled in Region 4 to date, produced 265 miles of new roads, 12.6 percent of the total roads in the Region. This then is the estimate of the portion of all oil and gas roads that could contribute to the displacement effect on mule deer and elk. It is adjusted in each case by the percentage of wells drilled in each species' winter range, 88 percent for mule deer and 53 percent for elk. Thus, the impact of all oil and gas roads on mule deer winter range is estimated at 16,808 acres (151,590 acres times 12.6 percent times the 88 percent of all wells that were located in mule

deer winter range), averaging 24 acres per well. This average is assumed for future cumulative impacts on mule deer winter range.

For elk, a similar process yields an estimated 16,385 acres (245,357 times 12.6 percent times 53 percent) or 23 acres per well, which is assumed for future cumulative indirect impacts on elk winter range.

Raptors

A comprehensive list of raptors nesting in Region 4 is listed in Appendix G. Although limited inventory has been done, the available information is stored in a GIS database associated with WRIS, developed through an interagency effort.

Direct Impacts. Direct impacts would include destruction of active raptor nests, collision with vehicles, and electrocution from power lines. The destruction of active nests is most likely to occur during the construction phase; however, collisions and electrocutions could occur during all phases. The increased road network would provide more access and illegal shooting could cause some losses of raptors.

Indirect Impact. Indirect impacts include destruction of inactive nests, disturbance and stress associated with human activity in the vicinity of a raptor nest resulting in disruption of the nesting cycle, leading to nest abandonment or mortality of young. This can occur during all phases; however is most likely to occur during the *construction phase* or "workover" period of the *operational phase.*

Raptors that are compelled to abandon their nests may be forced to select other nest sites in areas with lower prey bases which may not be capable of supporting nesting pairs of raptors. Some suitable habitat may be removed from use due to excessive noise associated with permanent facilities such as compressor stations. The raptor prey base would be reduced by construction activities through displacement or loss of habitat (prey base nests and dens, food sources, etc.) and by vehicle collisions.

The *abandonment phase* could impact raptors that started nesting after the construction phase through the short term disturbance associated with reclamation. In the long term, abandonment would have positive effects as a result of reduced human activity and the return of the disturbed area to a vegetated state.

Upland Game Birds

Turkey, chukar, blue grouse, and sage grouse may experience increased mortality during construction and operation from increased vehicle traffic; however, because of their high reproductive rates, this is unlikely to have any substantial effect on populations in Region 4. All of these species are mobile and unlikely to be killed or injured by other construction activity. Losses of habitat value and populations are assumed to be proportional to the area directly disturbed within the vegetation types representing their general habitat.

Direct impacts on preferred habitat may have a detrimental impact on turkey production areas which are typically associated with riparian zones and the immediately adjacent mountain shrub communities. Chukar habitat may in fact be improved if there is an increase in cheatgrass associated with disturbance. Sage grouse and blue grouse habitat generally does not fall within the development area and is unlikely to be impacted to any degree. In other portions of the resource area, gas development could negatively impact sage grouse leks, nesting habitat and winter range.

Waterfowl and Shorebirds

Important waterfowl and shorebird nesting in habitat in Region 4 is generally associated with the Colorado River, gravel pits in the vicinity of the river, Fravert Reservoir and other lakes and

reservoirs located mostly on USFS-administered lands. Other areas of importance in the GSRA include King Mountain Reservoir and the Colorado, Roaring Fork and Eagle Rivers. Any activity within or near the riparian zone of these areas during the nesting season could have a detrimental impact on those nesting species.

Predators and Furbearers

Riparian dependent species such as beaver, mink and muskrat are unlikely to be impacted to any great degree if riparian zones and buffer areas immediately adjacent are protected. Predator species such as coyote, fox, bobcat, etc., will be impacted to the degree that their food base is impacted. In highly developed areas, small mammal and bird populations can be expected to decline and thus predators will be forced to move. None of these species is expected to be seriously impacted because of the size of their range and/or the habitat used.

Small Game and Non-game Species

Small prairie dog towns are located in Region 4, west of Una and near the Roan Cliffs. If development occurs within the boundaries of these towns, it could cause a reduction in the prairie dog populations. Disturbance during the construction phase could directly disturb or destroy most prairie dog mounds within these towns. There would likely be increased direct mortality from construction activities, increased numbers of vehicles, and from recreational shooting. This could have a substantial long-term adverse effect on prairie dog populations and those of associated sensitive species in Region 4.

Impacts on non-game birds resulting from the gas development consist of direct mortality from increased human activity and traffic. Indirect impacts consist of displacement from nesting habitat, an increase in cowbirds and other corvids in response to fragmentation and habitat loss. Short-term direct loss of individuals and nest sites can occur in all habitat types during construction activities in the breeding season. Long-term loss of habitat and displacement of birds from breeding habitat also occurs in areas with wells, roads and facilities and high human activity. Although areas of short-term impacts have been revegetated to some degree, their value for songbirds would be reduced for 10-15 years until shrubs are re-established and approximate their original size. Those species associated with some semi-desert scrub, juniper and mixed mountain shrub communities would be most affected as most of the development has occurred in these habitats.

The many other small and non-game species, including desert and mountain cottontail, white tailed jackrabbit, and a variety of squirrels, mice, voles, reptiles and amphibians are relatively common throughout Region 4. Ground disturbing activities such as road and wellpad construction displace, kill or injure small mammals, reptiles and amphibians in the construction zone and more roads and traffic cause increased mortality during both the construction and the operational phases. Areas occupied by above-ground facilities mostly become non-habitat for the life of the project, while areas affected short-term during construction of pipelines and transmission lines may have a reduced carrying capacity for several years until vegetation re-establishes. These small mammals and reptiles are in all of the vegetation types, while amphibians are most likely found in riparian and agricultural areas and in the vicinity of streams and springs. To date, less than one percent of the general small mammal, reptile and amphibian habitat on BLM- managed minerals has been destroyed or altered during construction and operation.

Due to the density of road development occurring within the area of most intense development, death from collisions with motor vehicles and recreational shooting may be greater than that resulting from loss of habitat. The greatest impact would be to those species associated with the semi-desert scrub, juniper and mixed mountain shrub communities as most

development will likely occur in these habitats. Important reptile and amphibian habitat (dens, concentration areas and wetland, seeps and riparian areas) can be identified through survey and avoided or impacts mitigated. Animals displaced due to physical habitat loss would be subject to a greatly increased chance of predation.

4.5.3 Impacts to Date

BLM Impacts to Date

Most wildlife species have been affected to some degree by the loss of habitat, both directly and indirectly. However, with current available information, only impacts to mule deer and elk are readily quantifiable. All of the wells on BLM-managed surface and subsurface minerals are in mule deer winter range while about 50 percent are in elk winter range.

The disturbance on BLM-managed minerals has averaged 1.9 acres per well pad and 1.5 acres of road, pipeline and transmission line, a total of 3.4 acres per well. About half of this loss is short-term, up to 10 years, and the rest is long-term or permanent. To date, 160 wells, resulting in 544 acres of disturbance (Table 4.5-1), have been drilled on BLM-administered leases. 30 of these wells are located in the NOSR Production Area. Since all of these wells have been located in mule deer winter range, the direct loss of mule deer, and other species' habitat due to BLM-authorized activities has been 544 acres, a small part of the total mule deer winter range in the area of concentrated development, 147,466 acres. Habitat loss in the NOSR Production Area was 102 acres. The development to date on elk winter range, 81 wells, directly impacted 275 acres.

Table 4.5-1 Summary of Impacts on Deer and Elk Winter Range, Region 4 **

	Impacts to Date		Future Impacts			
	BLM	Cumulative Impacts	Alternatives			Cumulative Impacts
			Current Management	Maximum Protection	Proposed Action	
Total Wells	160	700	300	280	290	1,200
NOSR Wells*	30		70	55	65	
Disturbance (Acres)	544	2,380	870	748	782	4,080
NOSR Disturbance*	91		204	136	170	
Deer Winter Range						
Direct Impact (Acres)	544	2,094	870	748	782	3590
NOSR Direct Impact*	91		204	136	170	
Indirect Impact (Acres)	4,093	16,016	6,656	5,720	5,980	31,200
NOSR Indirect Impact*	1,536		3,840	2,560	3,200	
Elk Winter Range						
Direct Impact (Acres)	275	1251	462	398	415	2,162
Indirect Impact (Acres)	3,312	15,088	5,576	4,797	5,002	52,800

* Numbers for the NOSR Production Area are part of the BLM total.
** The indirect effect on winter range is increasingly overstated over time because the buffers will tend to overlap each other.

As described earlier, this analysis uses displacement zones created by roads to express indirect effects on deer and elk. Other species are also indirectly affected by this development to varying degrees. Indirect effects, including avoidance/displacement and increased energy loss, have been quantified for mule deer by buffering the pads and associated roads to represent a displacement zone where habitat effectiveness is reduced in proportion to the density of the roads. For mule deer, the acreage indirectly affected due to BLM-authorized gas development is 4,093 acres. This represents about three percent of the mule deer winter range in the area of most intense development. Of the elk winter range in the same area, an estimated 3,312 acres, about 2.5 percent, have had a displacement influence as a result of developments on BLM-managed surface and mineral estate.

4.5.3.2 Cumulative Impacts to Date

Of the 700 wells drilled in Region 4 since oil and gas development activity began, an estimated 616 wells have been drilled in mule deer winter range, resulting in approximately 2,094 acres of disturbance and long-term habitat loss. This amounts to less than one percent of total mule deer winter range. An estimated 368 wells were drilled on elk winter range, resulting in 1,251 acres (0.5 percent) of disturbance and long-term habitat loss.

The total displacement effect on mule deer winter range from *all* sources of development was calculated at 151,590 acres, about 55 percent of the mule deer winter range in Region 4. The share of this displacement effect caused by all oil and gas roads is an estimated 16,808 acres (4,093 acres on BLM-managed minerals), representing about eleven percent of mule deer winter range in the area of concentrated development. The impact of displacement brought on from oil and gas development may actually be more intensive because the majority of the development is concentrated on mule deer *severe* winter range.

Of the total elk winter range in Region 4, 261,789 acres, almost all of it, 94 percent, came under the displacement effect of roads, using a 1/2 mile buffer. The amount of this displacement effect caused by all oil and gas roads is an estimated 16,385 acres (3,312 acres on BLM-managed minerals), representing about fifteen percent of elk winter range in the most intensely developed area.

Another indicator of displacement effects on winter range, and wildlife habitat in general, is road density. Road densities exceed 5 miles/square mile along the I-70 corridor from New Castle to Parachute Creek and up Parachute Creek approximately five miles. Most of the road development just north of the Colorado River is directly associated with natural gas development. Road densities of 3-5 miles per square mile are common throughout much of the rest of the area of concentrated impact (Map). As described earlier, the degree of the impact on the habitat and its ability to support deer and elk is directly related to road density. As road densities reach 4.5 miles or more per square mile, the reduction ineffectiveness can reach 50 percent.

Other activities have also affected wildlife in Region 4. The construction of I-70 and its associated big-game-proof fence and the adjacent railroad have altered and fragmented habitat in the Colorado River valley. Migration corridors between summer and winter ranges were effectively cut. Population growth has accelerated in the area. approximately 10,400 acres of subdivisions had been approved in Region 4 by 1997. Subdivision development often occurs in winter range, brings about invasion of noxious weeds and increased traffic, with its associated disturbance and displacement

4.5.4 Future Impacts

4.5.4.1 Continuation of Current Management Alternative

An additional 300 wells are anticipated on BLM surface and subsurface minerals over the next 20 years. This new development would occur through increased well density in currently developed areas and expansion into new undeveloped areas, generally in the area of concentrated development. The surface disturbance and equivalent direct impact on mule deer would be approximately 1,020 acres, assuming an average disturbance of 3.4 acres per well.

Of these new wells, 230 would be drilled on leases that were issued with the Standard Lease Terms and Conditions. This allows for a move of up to 200 meters and/or a timing limitation of up to 60 days. Additionally, Conditions of Approval (COAs), such as remote monitoring and offsite mitigation could be attached to the approvals to drill to mitigate impacts as long as they don't interfere with the rights granted under the lease. There is also an opportunity for BLM and the operator to agree to relocations and timing limitations beyond those allowed under the Standard Terms and Conditions.

70 of the wells, those in the NOSR Production Area, would be located on new leases on which the stipulations outlined in the 1991 FEIS would be applied under this alternative.

Direct and indirect acreage impacts to deer and elk have been projected under each alternative (Table 4.5-1) In this alternative, it is projected that 1,020 acres of mule deer winter range would be directly disturbed by gas developed under BLM-authorization. The indirect impact of these wells and associated roads affects a displacement zone of 7,800 acres. This is about four percent of the mule deer winter range in the development area. This area would become less effective as habitat for mule deer in proportion to the density of the road network. As densities increase with the infilling of established fields, the effectiveness of the habitat to support mule deer decreases.

Elk winter range would also be impacted both directly and indirectly by BLM-authorized gas development. Fewer of the locations would be on elk winter range and the direct disturbance in this alternative is projected to be 510 acres. The indirect impact, utilizing a 1/2 mile buffer on pads and associated roads in elk winter range is projected to be 6,300 acres (about four percent of the elk winter range in the area of concentrated development).

The stipulations that can be attached to new leases, primarily in the NOSR Production Area, are found in Appendix F.

Stipulations that affect wildlife in this alternative are:

- A Controlled Surface Use stipulation (CSU) which allows a relocation of more than 200 meters, so that riparian vegetation can be completely avoided;
- A No Surface Occupancy (NSO) stipulation to protect State wildlife areas and fish hatcheries (none in the NOSR Production Area);
- NSOs of varying radii to protect most raptor nests, bald eagle roosts and nests, peregrine falcon nests, Mexican spotted owl roosts and nests, waterfowl production areas, rookeries and leks;
- Timing limitations (TL) on big game crucial winter habitat and birthing, for sage grouse crucial winter habitat, for most raptor nesting and fledging (varying dates and buffer zones; there are no sage grouse in the NOSR Production Area);
- A Lease Notice (LN) that sensitive plant or animal populations may require inventory prior to approval of operations and sage grouse nesting habitat.

These stipulations would provide an increased level of protection for these species and their habitats in the NOSR Production Area. They do

not legally apply to the majority of the habitat in Region 4. Of the 300 assumed new wells under BLM authorization, only 70 of these would be in areas where these stipulations would be attached to leases.

The Standard Terms and Conditions of the leases provide some protection to the species of concern; the Endangered Species Act and BLM policy protects listed, proposed, and to a lesser extent, candidate and sensitive species; and the Migratory Bird Treaty Act protects raptors. However, much of the protection the BLM desires must be accomplished through COAs (which can't infringe on lease rights) and voluntary agreement with the operators. The most important wildlife protections to be pursued through voluntary agreements and COAs include timing limitations and protection of the high value habitat areas, including the seclusion areas, riparian areas and special status species habitat.

4.5.4.2 Maximum Protection Alternative

The difference between the Maximum Protection Alternative and the Continuation of Current Management Alternative lies in the stipulations applied to new leases. Under this alternative, additional restrictive measures would tend to reduce slightly the number of wells to perhaps 280, of which 55 might be in the NOSR Production Area. Due to these reduced numbers, the direct and indirect impacts to mule deer and elk would decrease somewhat. As shown in Table 4.5-1, the surface disturbance associated with the locations is 952 acres, 187 in the NOSR Production Area. That is also the amount of direct impact to mule deer winter range. The indirect impact is calculated as 7,280 acres, 1,430 in the NOSR Production Area. This is a decrease from the acreage impacted under the Continuation of Current Management and the percentage of mule deer winter range in Region 4 indirectly impacted drops slightly. A similar situation exists for elk. The direct impact in elk winter range is 476 acres. The indirect acreage affected would be 5,880, none of which is in the NOSR Production Area.

Under the Maximum Protection Alternative, the stipulations that would be applied to new leases will change. See Appendix F for a comparison of the stipulations.

The stipulation differences between current management and maximum protection include:

- A NSO from the vegetation out 500 feet to protect riparian and wetland areas;
- A NSO to protect wildlife seclusion areas;
- A NSO 1/4 mile from the high water mark of the King Mountain reservoirs to protect waterfowl areas;
- A NSO on habitat for Federal and State T&E, Federal proposed or candidate, and BLM sensitive species;
- A CSU for perennial water impoundments and streams, since riparian areas are now covered by a NSO;
- The LN for sage grouse habitat was eliminated (leks are protected by a NSO, crucial winter habitat by a TL).
- A series of Conditions of Approval (COAs) aimed at restricting activities that might adversely affect wildlife.

Some of these stipulations would provide more protection for these species and their habitats in the NOSR Production Area; they don't apply to the majority of the habitat in Region 4. Of the 280 assumed new wells, these would legally apply to 55.

However, under this alternative in the NOSR Production Area, riparian zones and the adjacent habitat receive increased protection, several wildlife seclusion areas will be protected, the King Mountain Waterfowl Area will be buffered from development and special status species habitat would receive increased protection, especially those species not listed as Threatened or Endangered.

4.5.4.3 Proposed Action

The difference between the Proposed Action and the other alternatives is the stipulations applied to any new leases.

Under the Proposed Action (Table 4.5-1), 290 wells on public mineral estate are assumed, including 65 wells in the NOSR Production Area. The direct and indirect impacts to mule deer and elk will be between the Current Management and Maximum Protection alternatives.

The surface disturbance associated with these locations is 986 acres, 221 acres in the NOSR Production Area. This is also the direct impact to mule deer winter range. The indirect impact is calculated to be 7,540 acres, 1,690 acres in the NOSR Production Area, somewhat between the other two alternatives.

Elk winter range is affected similarly. The direct impact in elk winter range is 493 acres. The indirect acreage affected would be 6,090 acres, approximately 2 percent of the elk winter range. None of the impact would occur in the NOSR Production Area.

The Proposed Action lease stipulations that would apply to new leases are found in Appendix F. The differences between the Maximum Protection Alternative and the Proposed Action include:

- A NSO on the riparian vegetation zone; the 500 feet of adjacent habitat is protected by a CSU;
- The NSO on the King Mountain waterfowl area has been removed; the area is afforded the same protection given to perennial water impoundments and streams;
- BLM sensitive plant and animal species are protected by a CSU rather than a NSO;
- Fravert Reservoir Watchable Wildlife area is protected by a TL;
- A LN requiring development of specific measures to reduce impacts of operations on wildlife has been added; A LN encouraging operators to develop, in conjunction with the CDOW, a set of operating procedures for employees and contractors working in important wildlife habitats has been added.

As previously stated, these stipulations can only be attached to leases in the NOSR Production Area. However, under this alternative, riparian vegetation is protected, important habitat adjacent to the riparian zones is avoided, several seclusion areas will be protected, the Fravert Reservoir Watchable Wildlife area will receive protection through a timing limitation, though the King Mountain Waterfowl Area will only receive the protection given to perennial water impoundments (CSU allowing movement beyond 200 meters).

Lease notices have been added that may require operators to work with the BLM and CDOW to develop measures to reduce impacts of their operations on wildlife. These can include habitat improvement projects, closing roads, use of telemetry, etc., in plans of development. Operators would also be encouraged to work with CDOW to establish operating procedures for their employees and contractors. These would help inform them of ways to minimize the effect their presence has on wildlife.

4.5.5 Cumulative Impacts

The cumulative effect on mule deer habitat from the future development of 1,200 wells in Region 4 is a direct impact on 3,590 acres of winter range which are physically disturbed and an indirect effect of 28,200 acres, about 11 percent of the mule deer winter range in Region 4. When that is added to the acreage impacted by oil and gas development to date, 16,808 acres, a total of 45,008 acres of would have been affected.

The cumulative effect of all gas development (1,200) wells on elk winter habitat is a direct impact on 2,162 acres and an indirect impact on 14,628 acres. This represents approximately

20% of the elk winter range in Region 4. When added to the indirect acreage impacted by oil and gas development to date, 16,385 acres, the amount of elk winter range that may be impacted by oil and gas development is about 31,000 acres. Due to the width of the road buffer for elk (one-half mile on either side), the indirect impact acreage is overstated to some degree as each road buffer tends to overlap other road buffers; road densities will continue to increase, further reducing habitat effectiveness.

When all currently mapped roads in Region 4 were buffered and intersected with elk winter range, 94 percent of the winter range (245,357 acres) have been impacted to some degree. Therefore, much of any new road development attributable to oil and gas development in the future would likely result in increased road density and increased traffic in elk winter range rather than indirect influence on new parts of the winter range. This effect would of course bring about a corresponding decrease in habitat effectiveness and therefore reduce its carrying capacity. Elk summer and calving areas south of the Colorado River may become more impacted as the development moves upward in elevation.

Activities other than oil and gas development will also affect wildlife in Region 4 in the coming years. Continued subdivision development, converting agricultural and other lands into residential uses, is expected. This type of development usually occurs in winter range. Population growth also brings with it an increase in recreational activity in the area. The use of Off-Highway-Vehicles (OHVs) brings recreationists into areas previously inaccessible to motor vehicles. This further fragments habitat and reduces habitat effectiveness.

4.6 Special Status Species

4.6.1 Impacts to Date

BLM Impacts to Date: ***Plants***. Typical impacts on the known special status plant populations include: competition from noxious weeds and other invasive plants, trampling and grazing damage, destruction of plants from human development and activity.

Upon receipt of a Notice of Staking or an Application for Permit to Drill from the gas leaseholder, BLM determines whether potential habitat for any special status species exists within the area. A botanical inventory is conducted of any potential habitat within the project site. If the inventory discovers any special status plants which may be affected by the project, the plants are either avoided or impacts are mitigated. The intent of mitigation is to reduce impacts on populations of rare plants to a minimum.

Little oil and gas activity in Region 4 has occurred in the proximity of any special status plants. However, in those instances in which special status plants were identified in the vicinity of the activity, mitigation has not always been effective. In one instance, a wellpad was relocated less than 10 feet to avoid a population of BLM Sensitive plants. Subsequent visits to the site determined that the new road and pad had become a conduit for livestock travel and the rare plants had been damaged by grazing and trampling. Other pads have been relocated 20-30 feet to avoid portions of a population, but the remainder of the population was destroyed. A DOE proposed well bore was in the midst of a 2-3 acre population of rare plants. DOE moved the pad slightly to avoid the highest concentration of the plants but did destroy a sizeable number of individuals. DOE also constructed a fence around the pad to minimize off-site impacts to the rare plant population.

In another case, a proposed well location that would have destroyed several dozen BLM Sensitive plants. The BLM conducted an on-site visit after the T&E survey revealed the presence of a rare plant. Alternative pad sites would have required greater cut and fills and created more impacts to the drainage. The pad was moved slightly to avoid a clump of the rare plants, but another dozen or so were directly impacted by pad construction.

Within Region 4, the isolated impacts to date have not had a substantial negative effect on the entire populations of these rare plants. However, as oil and gas development continues and well density increases, the potential impacts are magnified. A large population of a BLM Sensitive plant has recently been discovered in the Beaver Creek drainage. Most of the gas wells drilled in this watershed to date have not been in occupied habitat. However, numerous wells are being proposed within the occupied habitat, and protection may require substantial changes in pad placement and access road design.

Wildlife. Only limited inventory information exists on bald eagles, peregrine falcon, northern goshawk and the Colorado River fish including humpback chub, bonytail chub, Colorado squawfish, Colorado River cutthroat trout and razorback sucker. Section 7 consultation with the USFWS has been completed on any actions that had a likelihood of affecting known populations of these species.

No inventories (other than for the northern goshawk) have been completed in Region 4 for the other species included on the Sensitive species list included in Chapter 3. A small number of past APDs have had a limited raptor survey completed on them, with no raptors observed; however, these surveys are not completed on a regular basis.

Impacts that likely have occurred include habitat destruction, habitat disruption during critical periods, indirect loss of habitat and direct mortality.

Cumulative impacts to date: ***Plants.*** Some populations of rare plants are experiencing competition from noxious weeds and other invasive plants. These populations are close to roads and other disturbance, so it is likely the disturbance contributed to the establishment of the weeds.

Outside of Region 4, certain rare plants are being heavily impacted by housing subdivision projects and other commercial development. Special status plants which occur on privately owned land are not protected under the Endangered Species Act, therefore any protection provided is on a voluntary basis. If impacts on private land continue to increase, then the populations which occur on public land become even more important to the survival of the species.

Wildlife. Sensitive wildlife species are likely being negatively impacted both throughout Region 4 and in the rest of the GSRA as a result of development on private lands; however, again, without inventory information prior to development, this can only be speculated upon. On public lands, major commercially driven actions such as pipelines, power lines, etc. do receive field inventories by approved contractors prior to approval, while BLM driven actions are reviewed in-house, with field surveys conducted as necessary. Appropriate mitigation is developed and implemented, thus reducing or eliminating detrimental impacts.

Special status wildlife species which occur on privately owned land are provided some protection under the ESA if knowledge of the species exists and if the action occurring, is authorized in some fashion by a Federal agency. Development of private and public lands is increasing at a rapid rate, making the protection of the remaining viable habitat for special status species even that more critical in the future, for the survival of viable populations in the GSRA.

4.6.2 Future Impacts

The following analysis is based upon the assumption that adequate pre-development inventories are completed and the information is available prior to authorizing actions that might have a detrimental impact to any special status species.

Under all alternatives, T&E species found on existing leases are protected under the Endangered Species Act (ESA). These species and their habitats should be adequately protected by the provisions of the Act. Section 7 consultation with the USFWS is required on all actions having the potential to affect listed T&E species or adversely modify or destroy designated critical habitat and additional mitigation may be identified through this process. If the action is likely to jeopardize a proposed species or cause destruction or adverse modification of proposed critical habitat, consultation with the USFWS is required which may also result in additional mitigation.

Candidate and sensitive species are protected by BLM policy, which directs BLM not to contribute to the need to list a species in the case of candidate and sensitive species, as long as it does not unduly hinder lease rights granted. These species are covered under the Standard Terms and Conditions unless otherwise stipulated in the lease. However, additional movement beyond 200 meters or longer timing restrictions may be imposed as long as there is supporting site specific analysis that leads to the determination by the AO that undue and unnecessary degradation will occur. Sensitive raptors are afforded additional protection by other Federal and State laws listed in Chapter 3.

Inventories of potential habitat may be required for Special Status species or significant natural plant communities. The inventories will be used to develop appropriate mitigation to protect these resources.

4.6.2.1 Continuation of Current Management Alternative

The Continuation of Current Management Alternative would implement the stipulations developed in the FEIS on new leases. The protective stipulations include a No Surface Occupancy (NSO) stipulation on habitat areas for listed, proposed and candidate plant species. Sensitive raptor nest and roost sites are also protected with NSOs of variable radius depending on the species. These NSOs are applied to locations known prior to issuance of the lease. New NSOs cannot be added to the lease after the lease has been issued. If subsequent inventories locate additional special status plant or animal populations, these populations are protected through the Standard Terms and Conditions, including the option to increase the protection, if site specific analysis leads to an undue and unnecessary degradation determination. T&E species and sensitive raptors enjoy the additional protection discussed above.

The AO may make exceptions to the NSOs after important factors are considered in the impact analysis such as the type and amount of surface disturbance; plant frequency and density; the relocation of disturbances; relative abundance of habitat; the species and location of animals; the active status of nests and the presence of topographic or vegetative screening. Issues affecting sensitive raptor species may also require consultation with the USFWS and CDOW. On new leases, the NSO stipulation on listed, proposed and candidate species should fully protect those species and habitats identified prior to lease issuance.

Sensitive species and significant natural plant communities would be protected only by the Standard Lease Terms and Conditions, unless site specific analysis supports a determination of undue and unnecessary degradation. If an undue and unnecessary degradation decision is not made, loss of individuals and populations may

occur which might create adverse impacts to the viability of certain populations.

4.6.2.2 Maximum Protection Alternative

With the Maximum Protection Alternative, all special status species and their habitat that has been identified prior to issuing a lease would be protected with a No Surface Occupancy restriction. The NSO may be altered after the AO has considered each of the factors mentioned in the Continuation of Current Management Alternative and determines that the impact to the species will be insignificant. Once a lease has been issued, any new locations of listed species or their habitat would be still be protected by the ESA. New locations of other Special Status species would receive the protection provided by the Standard Lease Terms and Conditions, including the undue/unnecessary degradation consideration, unless additional protection is voluntarily agreed to by the developer.

4.6.2.3 Proposed Action

Listed species, and proposed and candidate species for listing would receive protection similar to that discussed under the Maximum Protection Alternative. The primary difference between the Maximum Protection Alternative and the Proposed Action Alternative is that BLM Sensitive species are protected by a CSU stipulation rather than an NSO. The CSU may require relocating oil and gas activities by more than 200 meters or other mitigating measures designed to protect the species and its habitat. The CSU provision should be adequate to protect Sensitive species in most cases. However, in some situations where populations are widespread or the habitat needs are extensive, even a move of greater than 200 meters may not be provide sufficient protection.

Given compliance with the ESA, Federal and State Laws and BLM Policy, and any additional measures identified by the BLM, significant direct impacts to special status species are not anticipated. Implementation of mitigation measures to prevent/reduce the potential for noxious weed introduction and spread in areas of potential habitat and to reduce the potential for grazing or trampling damage would minimize the potential for negative indirect effects to plant communities. Voluntary implementation of timing limitations and other necessary mitigation developed during the POD phase could help minimize potential for negative indirect effects to wildlife species and their habitats.

4.6.3 Cumulative Impacts

The cumulative effect of impacts due to oil and gas activities and impacts created by gas drilling on priority mineral estate and by other human activities may create sufficient disturbance that some of the special status species may be placed at risk.

4.7 Wild Horses

The Wild Horses portion of the Environmental Consequences section was discussed on pages 4-10 and 4-11 of the FEIS. There are no managed populations of wild horses in the GSRA and they are not discussed in this SEIS.

4.8 Soils

Impacts resulting from oil and gas development include removal of vegetation, exposure of the soil, mixing of soil horizons, soil compaction, loss of top soil productivity, increased susceptibility of the soil to wind and water erosion. Wind erosion would be expected to be a minor contributor to soil erosion in Region 4 with the possible exception of dust from vehicle traffic. These direct impacts could result in increased runoff, erosion and off-site sedimentation and subsequently increase the loss of the base natural resource. Additionally, they could create remediation challenges in areas with soils of poor to very poor reclamation potential.

Activities that could cause these types of impacts include construction and operation of well sites, access roads, gas pipelines, and ancillary facilities as described in detail in Appendix A. Contamination of soils from drilling and production wastes mixed into soils or spilled on the soil surfaces could cause a long term reduction in site productivity. Most of these impacts can be reduced or avoided through implementation of mitigation methods discussed in Appendix E (Mitigation Common to All Alternatives) and Appendix I (Reclamation).

4.8.1 Impacts to Date

BLM Impacts to Date. Oil and gas development has produced both short-term and long-term effects to the soil resource. The short-term impacts include removal of vegetation, exposure of the soil, mixing of soil horizons, soil compaction, loss of top soil productivity, increased susceptibility of the soil to water erosion. These have occurred during the construction of pads, roads, pits, and other ancillary facilities. Initially, impacts can be minimized by stockpiling of the top soil and controlling erosion during construction. Following drilling, rehabilitation of disturbed surface begins within days. Much of the original disturbance, including cut and fill slopes, that is not needed for operations is reshaped and revegetated. Soil compaction and soil mixing may reduce soil productivity in the short-term on rehabilitated sites following initial construction. Generally, soil erosion is higher on recently rehabilitated sites and decreases over time to preconstruction or lower levels in about 3 years.

On wells, access roads, and ancillary facilities that are required over the life of the oil and gas production cycle, a long-term commitment of soil resources would occur. Such sites generally remain non-productive and continue to be at risk of erosion and weed infestation. Soil erosion from these facilities is usually minimized by maintenance of roads, construction of waterbars, construction of drainage ditches, and efforts to minimize the size of working surfaces. Long-term compaction of soil on working surfaces would occur. Current GSRA practice calls for use of stockpiled topsoil within a short period of time or it must be protected in a way that will maintain its productivity.

Oil and gas development on the 162,635 acres of public land in Region 4 (including the NOSR Production Area) has resulted in the construction of 160 well pads and 544 acres of associated surface disturbance (Table 4.8-1). With the average wellpad size of 1.9 surface acres, a total of 304 acres were disturbed for well pad construction. An additional 1.5 acres of surface disturbance occurred on average for pipelines and roads to access each well pad, resulting in 244 acres of additional disturbance. After application of reclamation measures, the long-term commitment of surface/soil for oil and gas production has totaled 304 acres for 160 producing wells (This includes the 30 wells drilled by DOE in the NOSR Production Area.). This is an average long-term impact of 1.9 acres per location, 0.4 acres for well pads and 1.5 acres for roads. The amount of disturbance on highly erosive soil is 37 acres.

The total effect on the soils from oil and gas development on BLM-managed mineral estate in Region 4 has been minimal, given the application of mitigation to reduce erosion and enhance productivity. Less than one percent of the soils in Region 4 have been impacted. While construction of wellpads, roads, pipelines, and related facilities may result in a large amount of soil being moved locally in the short-term, any increases in regional soil erosion and resulting sedimentation would not be distinguishable from natural variation in the area. An event that occurred in September of 1997 illustrates this point. A high intensity thunderstorm created a debris flow that temporarily closed Garfield County Road 215 approximately 3 miles north of the town of Parachute. The debris flow came from watersheds with no oil and gas activity.

Table 4.8-1 Surface Disturbance to Date and For All Alternatives, Region 4

	ACRES DISTURBED			ACRES IN USE (LONG-TERM)		
	TOTAL	ROADS	PADS	TOTAL	ROADS	PADS
Disturbance to date on BLM	544	240	304	304	240	64
Average per Well	3.4	1.5	1.9	1.9	1.5	0.4
Cumulative disturbance to date	2,380	1,050	1,330	1,330	1,050	280
Future disturbance on BLM (including NOSR)	BLM/ NOSR	BLM/ NOSR	BLM/ NOSR	BLM/ NOSR	BLM/ NOSR	BLM/ NOSR
Continuation of Current Management Alternative	1,020/ 238	450/ 105	570/ 133	570/ 133	450/ 105	120/ 28
Maximum Protection Alternative	952/ 187	420/ 83	532/ 104	532/ 104	420/ 83	112/ 22
Proposed Action	986/ 222	435/ 98	551/ 124	551/ 124	435/ 98	116/ 26
Cumulative Future Disturbance	4,080	1,800	2,280	2,280	1,800	480

Cumulative Impacts to Date. An estimated 540 wells have been drilled on private land. Assuming the average disturbance on fee wells is the same as for BLM wells, 1.9 acres for the well pad and 1.5 acres for the road, then 1,836 acres have been disturbed by oil and gas development on private property (2,380 acres for all 700 wells; see Table 4.8-1.). Assuming all but an average of 1.9 acres per well disturbance on public and private land have been rehabilitated, the long-term commitment of surface/soil for the oil and gas production on all lands has amounted to 1,330 acres for 700 wells. The total effect on the soils from oil and gas development in Region 4 has been minimal, assuming the application of mitigation to reduce erosion and maintain or enhance productivity. Less than one percent of the soils in Region 4 have been impacted. While construction of wellpads, roads, pipelines, and related facilities may result in a large amount of soil being moved locally in the short-term, any increases in regional soil erosion and resulting sedimentation would not be distinguishable from natural variation in the area.

4.8.2 Future Impacts

4.8.2.1 Continuation of Current Management Alternative

Under the Continuation of Current Management Alternative, soils would be protected by a NSO stipulation on critical watershed areas identified in the RMP and by two CSU stipulations, one aimed at maintaining site productivity and controlling erosion in highly erosive soil areas; and the other aimed at maintaining productivity and controlling erosion on sites with over 40 percent slope. These stipulations would attach to new leases in the NOSR Production Area and would define management objectives for development on already existing leases.

For the 300 new wells anticipated to be drilled on BLM-managed mineral estate during the next twenty years, an estimated 1,020 acres of associated surface disturbance would result. Seventy of these wells would be drilled in the NOSR Production Area resulting in 238 acres of associated disturbance. A total of 48 acres of highly erosive soils would be disturbed.

The anticipated short-term and long-term impacts to soils are assumed to be similar to those that have occurred to date, although the magnitude of impact would be greater because of the higher number of anticipated new wells. In the short-term, 1,020 acres of public land would be disturbed. Rehabilitating measures would be implemented shortly after drilling is completed at each site, resulting in the eventual rehabilitation of 450 acres of public land. The long-term commitment of 570 acres would be required for roads and production facilities. This is a worst case analysis where every well would be a producing well and therefore would have long-term impacts.

The total effect with the Continuation of Current Management Alternative on the soils from oil and gas development on public land and on split estate would be minimal, totaling less than one percent of the Region 4 area. While construction of 300 well pads, associated roads, pipelines, and related facilities may result in a large amount of soil being moved locally in the short-term, any increases in regional soil erosion and resulting sedimentation would not be distinguishable from natural variation in the area. Over the next 20 years, urbanization of private land is anticipated to continue and would disturb far greater acreage than that anticipated from oil and gas development on BLM-administered mineral estate.

4.8.2.2 Maximum Protection Alternative

The Maximum Protection Alternative would place additional constraints on gas development to protect soil resources. This alternative would impose a NSO stipulation for oil and gas development on highly erosive soils, including areas identified in the RMP as Erosion Hazard Areas. Exceptions to the NSO requirement

would be allowed by approval of the AO for site development plans that: 1) would maintain the soil productivity of the site, 2) would protect off-site areas by preventing accelerated soil erosion (such as land sliding, piping, mass wasting) from occurring, and 3) would protect water quality and quantity. Another NSO would prohibit activity on all slopes over 35 percent to protect soils and watersheds. Additionally, a Site Disturbance and Stability NSO, with exceptions, on slopes greater than 25 percent would ensure that sites on steep slopes are managed for maximum reclamation potential.

The Maximum Protection Alternative would protect highly erosive soils and soils on very steep slopes with NSOs throughout the resource area. Since 95 percent of the public mineral estate in Region 4, outside of the NOSR Production Area, is already leased, implementation of the soil resource stipulations in Region 4 might be limited. Compliance with stipulated mitigation would be voluntary or would be based on COAs that do not restrain lease rights. Only one of the RMP-designated erosion Hazard Areas is in Region 4, the Divide Creek/Center Mountain Erosion Hazard Area. This Erosion Hazard Area was leased prior to 1984 and the wells that have been developed have not demonstrated soil erosion problems because of effective mitigation.

The anticipated short-term and long-term impacts to soils under the Maximum Protection Alternative would be similar to those described in the impacts to date section, although the magnitude of these impacts would be slightly less than the Continuation of Current Management Alternative. A projected 280 wells would be drilled, resulting in impacts on an estimated 952 acres of public land. Rehabilitating measures would be implemented shortly after drilling is completed at each site on approximately 420 acres of public land. The long-term commitment of 532 acres would be required for roads and production facilities. On public land, less then 35 acres of highly erosive soils would be disturbed.

The Maximum Protection Alternative would likely result in fewer wells and wellpad locations in the NOSR Production Area because of other environmental constraints, including protection of visual resources, protection of wildlife values, and protection of special status plant and animal species. An estimated 55 wells would be developed. The wellpads, roads, pipelines, and facilities would result in 187 acres of new disturbance in the NOSR Production Area.

4.8.2.3 Proposed Action

The Proposed Action would allow oil and gas development in the GSRA with a number of environmental protection constraints and mitigating measures. Stipulations that are specific to soil concerns in the Proposed Action are a CSU stipulation on highly erosive soils and a NSO stipulation on slopes over 35 percent. The CSU on highly erosive soils would allow BLM to require special design, construction, and implementation measures, including relocation of operations beyond 200 meters in identified areas of highly erosive soils. Areas identified in the RMP as Erosion Hazard Areas are included in this stipulation.

The NSO on steep slopes over 35 percent would allow the AO to refuse locations in areas where soil erosion problems and/or remediation would be too great. Unlike the Maximum Protection Alternative, the AO may make exceptions to the NSO for short stretches of steep road to access a location. Additionally, a Site Disturbance and Stability CSU on slopes greater than 25 percent would ensure that sites on steep slopes are managed for maximum reclamation potential.

The anticipated short-term and long-term impacts to soils would be similar to the impacts described in the impacts to date section. However, the magnitude of these impacts would be slightly less than the Continuation of Current Management Alternative. A projected 290 wells would be drilled, resulting in an estimated 986 acres of new disturbance on public land.

Rehabilitating measures would be implemented within days of disturbance at each site, eventually leading to reclamation on a projected 435 acres of public land. The long-term commitment of 551 acres of public land would occur for production facilities and roads. Less then 36 acres of highly erosive soils would be disturbed.

In the Production Area, the number of wells would increase to 65 wells from the 55 in the Maximum Protection Alternative. The 65 well pads, roads, pipelines, and associated facilities would result in 222 acres of new disturbance over the next 20 years.

4.8.3 Cumulative Future Impacts

It is anticipated that a total of 1,200 new wells would be drilled in the next 20 years in Region 4, concentrated primarily in the areas with current development. An average of 60 new wells would be drilled each year, 15 on public land. The proportion of future wells by land status, the amount of soil disturbance per well, and the proportion of multi-hole well pads is assumed to be proportionately the same in the future as is presently occurring. Consequently, oil and gas development would continue to have the same types of impacts to soils in the future as is presently occurring.

The new wells would impact an estimated 4,080 acres over the next 20 years. A projected 900 wells would be drilled on private property, and 300 wells on public land. Approximately 1,020 acres of public land and 3,060 acres of private land would be disturbed. Rehabilitating measures would be implemented within days of disturbance on a projected 450 acres of public land and on 1,350 acres of private land if reclamation efforts similar to BLM's were pursued. A long-term commitment of 570 acres of public land and 1,710 long-term acres of private land would occur for production facilities. This is a worst case analysis where every well would be a producing well and therefore would have long-term impacts.

The cumulative effect on the soils from oil and gas development would be minimal, totaling less than one percent of the area of Region 4. While construction of 1,200 wellpads, associated roads, pipelines, and related facilities may result in a large amount of soil being moved locally in the short-term, any increases in regional soil erosion and resulting sedimentation would not be distinguishable from natural variation in the area. Over the next 20 years, urbanization of private land is anticipated to continue and would disturb far greater acreage than that anticipated from oil and gas development on BLM-administered mineral estate.

4.8.4 Proposed Action

The preferred alternative is to allow oil and gas development in the GSRA with a number of environmental protection constraints and mitigating measures. Stipulations that are specific to soil concerns in the preferred alternative are a Controlled Surface Use (CSU) stipulation on highly erosive soils and a NSO on slopes over 35 percent.

The CSU on highly erosive soils would allow the BLM to require special design, construction, and implementation measures including relocation of operations beyond 200 meters, in identified areas of highly erosive soils. Areas identified in the RMP as Erosion Hazard Areas are also included in this Stipulation.

The NSO on steep slopes over 35% will allow the BLM's Authorizing Officer to refuse the oil and gas industry in areas where soil erosion problems and/or remediation would be too great. The AO may make exceptions to the NSO for a short stretch of steep road to access a location.

The projection for the Preferred Alternative is that the same number of wells would be authorized with the preferred alternative as with the Continuation of Current Management and Maximum Protection alternatives on private and on BLM land other then on the NOSR

Production Area. There would be an increase number of wells allowed on the NOSR Production Area to 65 wells on 50 well pads. The 50 well pads and associated roads, pipelines etc. would result in 170 acre of new disturbance on the NOSR Production Area over the next 20 years. On private property, 970 wells would be drilled on 827 well pads resulting in 2,812 acres of disturbance. An average of 60 new wells would be drilled each year with 12 of these located on public land. On public land, less then 36 acres of highly erosive soils would be disturbed.

The anticipated short and long term impacts to soils would be the same types of soil impacts as described in the impacts to date section. The magnitude of these impacts would be slightly less on public land and the same on private land as the Continuation of Current Management Alternative. In the short term, 225 wells would be drilled on 191 well pads resulting in 649 acres of new disturbance on public land. Rehabilitating measures would be implemented within days on the disturbance of public land and an expected 382 acres of public land would be rehabilitated in the short term. The long term commitment of 267 acres of public land would occur for production facilities. This is a worst case scenario where every well is expected to be a producing well and therefore have long term impacts.

The cumulative effect with the continuation of current management on the soils from oil and gas development on public land and on split estate property in the Glenwood Spring Resource Area will be minimal. Over the next 20 years urbanization of private land is also anticipated to continue and will disturb far greater acreage then that anticipated from oil and gas development. While construction of an additional 191 well pads, roads, pipelines, etc. on public land would result in more soil being moved for oil and gas development then the present situation, any resulting increases in soil erosion would not be distinguishable from background levels.

4.9 Water

Potential impacts that could occur due to the proposed project include increased surface water runoff and off site sedimentation due to soil disturbance; increased salt loading and water quality impairment of surface waters; channel morphology changes due to road and pipeline crossing; and contamination of surface waters by produced water. The magnitude of these 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 and time within which construction activity 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, and reclamation efforts. Construction activities would occur over a relatively short period; therefore, the majority of the disturbance would be intense but short lived. Petroleum products and other chemicals could be accidentally spilled resulting in surface and groundwater contamination. Similarly, reserve and evaporation pits could leak and degrade surface and ground water quality. Authorization of the proposed project would require full compliance with SEIS directives that relate to surface and ground water protection, Executive Order 11990 (floodplain protection), and the Federal Clean Water Act (CWA) in regard to protection of water quality and compliance with Section 404.

4.9.1 Surface Water

Potential impacts that could occur due to continued oil and gas development include increased surface water runoff and off site sedimentation due to soil disturbance; increased salt loading and water quality impairment of surface waters; channel morphology changes due to road and pipeline crossing; and contamination of surface waters by produced

water. The magnitude of these 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 and time within which construction activity would occur, and the timely implementation and success or 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 and reclamation efforts. Construction activities would occur over a relatively short period; therefore, the majority of the disturbance would be intense but short lived. Petroleum products and other chemicals could be accidentally spilled resulting in surface and groundwater contamination. Similarly, reserve and evaporation pits could leak and degrade surface and ground water quality.

4.9.1.1 Impacts to Date

Oil and gas activities have resulted in minimal adverse impacts to water resources. Some of the impacts affecting soils as described in Section 4.8 could also affect surface water. Table 4.8-1 summarizes the amount of surface disturbance for all activities to date and for future alternatives. These impacts could increase runoff, erosion and off-site sedimentation which could cause channel instability and degradation of surface water quality.

The short-term impacts to surface water are primarily an increase in sediment and, potentially, salinity that occurs while the surface is disturbed. Surface water is most susceptible to sediment and salt yield while facilities are under construction. Within days following completion of drilling, measures to mitigate the disturbed site are implemented. Generally, sediment and salt yield are slightly higher on recently rehabilitated sites and decrease over time to a negligible level in about 3 years.

Long-term impacts from oil and gas production occur on wellpads, access roads and ancillary facilities that are required during the oil and gas production cycle. Soil-compacted sites on driving surfaces and sites that are not revegetated contribute greater amounts of runoff then undisturbed and rehabilitated sites. Increases in peak flow can cause increases in channel and bank erosion. Runoff from exposed subsurface soil often contains higher than normal amounts of salts and other pollutants. Mitigating measures such as construction of waterbars, road maintenance, drainage ditches, and efforts to minimized working surfaces would decrease negative impacts. Long-term increases in runoff, channel bank erosion, sediment and salt yield are minimal to date from oil and gas development in Region 4.

An evaluation of surface disturbance gives an indirect indication of the level of impact oil and gas activity has had on water quality. The fact that the surface disturbance is very minimal indicates that impacts on water quantity and quality are also minimal. This conclusion is supported by an examination of a watershed such as the Parachute Creek Basin. The U.S. Geological Survey (USGS) collected water quality information in the late 1970's and early 1980's close to the mouth of Parachute Creek. This gage information was collected prior to any oil and gas activity in the Parachute Creek Watershed. Sediment loads ranged from a maximum daily load of 82,000 tons on July 31, 1976 to a minimum daily load of less then 0.005 tons on many days during 1977. Salinity levels as measured by conductivity varied from a maximum of 3,440 micromhos on June 4, 1977 to a minimum of 811 micromhos on May 21, 1980. The 1991 FEIS estimated that the average sediment contribution from public lands to surface waters is one ton per acre per year. Public lands in the Parachute Creek Basin contribute an estimated 2,780 tons of salt annually from the Parachute Creek watershed to the Colorado River. To date, oil and gas development has resulted in an estimated 150 acres of disturbance in the Parachute Creek watershed on public land. An additional 445 acres have been disturbed on private land, 595 acres of the total 141,000 acres in the watershed.

Any increase in sediment loads, salinity, or other degrading impacts to water quality from the present level of oil and gas development in the Parachute Creek Basin would not be distinguishable from the background levels measured by the USGS in the late 1970s and early 1980s.

When impacts from oil and gas development on public land throughout Region 4 are viewed in perspective with natural erosion and other man caused erosion, any impacts from oil and gas development would also be minimal and not distinguishable from background levels.

Cumulative short- and long-term impacts to surface waters resulting from oil and gas development in Region 4 have been minimal. Most of the area being developed is dry with runoff only occurring occasionally throughout the year. When runoff events do occur, sediment, salt, and other pollutant increases coming from oil and gas facilities cannot be distinguished from those coming from undisturbed areas in the rest of the basin.

4.9.1.2 Future Impacts

4.9.1.2.1 Continuation of Current Management Alternative

Under the Continuation of Current Management Alternative, the same mitigation measures that protect the soil resource and riparian areas also serve to protect water quality. A NSO stipulation on critical watershed areas identified in the RMP and three CSU stipulations, one aimed at maintaining site productivity and controlling erosion in highly erosive soil areas, one aimed at maintaining productivity and controlling erosion on sites with slopes over 40 percent, and a third protecting perennial streams, offer additional protection to surface water. It is anticipated that 300 new wells would be drilled on public land in the next 20 years in Region 4. The resulting surface disturbance is estimated at 1,020 acres, (Table 4.8-1, Soils). This surface disturbance would result in a short-term increase in sediment and salinity in surface waters and a potential increase in peak flows.

In the short-term, 3.4 acres per well would be disturbed and 2 acres of these would be remediated. Impacts to water quality would be expected to return to the same level on the remediated area as surrounding areas in natural condition. In the long-term, 1.4 acres per well would not be rehabilitated, but would be required for well maintenance during the life of production. These working surfaces could contribute a minimal increase in sediment, salt, and, potentially, peak flows over the life of the well. The intensity and duration of these impacts would be reduced by effective mitigation including water bars for roads, siting locations and roads away from drainages, maintaining riparian buffers, and others.

4.9.1.2.2 Maximum Protection Alternative

Under the Maximum Protection Alternative, the same mitigation measures that protect the soil resource and riparian areas would also protect water quality. These mitigation measures include a NSO stipulation for oil and gas development on highly erosive soils, a NSO stipulation on slopes over 35 percent, NSO stipulations for the protection of the Debris Flow Hazard Zones, Water Quality Management Areas and Municipal Watersheds, and a NSO stipulation on riparian areas (including a 500' buffer). Additionally, a Site Disturbance and Stability NSO, with exceptions, on slopes greater than 25 percent would ensure that the sites on steep slopes are managed for maximum reclamation potential. All of these stipulations would offer protection to surface water quality.

The anticipated short-term and long-term impacts to soils under the Maximum Protection Alternative would be slightly less than those described in the Continuation of Current Management Alternative. A projected 280 wells would be drilled, resulting in impacts on an estimated 952 acres of public land.

This surface disturbance would result in a short-term increase in sediment and salinity in surface waters and a potential increase in peak flows. The intensity and duration of these impacts would be reduced by effective mitigation including water bars for roads, siting locations and roads away from drainages, maintaining riparian buffers, and others.

4.9.1.2.3 Proposed Action

Under the Proposed Action, the same mitigation measures that protect the soil resource and riparian areas would also protect water quality. These measures include a NSO stipulation on slopes over 35 percent with an exception for short stretches of road, NSO stipulations to protect Municipal Watersheds and Debris Flow Hazard Zones, a NSO on riparian vegetation (with a CSU on the associated buffer area), a CSU stipulation on highly erosive soils, including areas identified in the RMP as Erosion Hazard Areas, and a Site Disturbance and Stability CSU on slopes greater than 25 percent to ensure that sites on steep slopes are managed for maximum reclamation potential. All of these stipulations would offer protection to surface water quality.

The impacts to surface water under the Proposed Action would be about the same as those for the Continuation of Current Management Alternative and the Maximum Protection Alternative. A projected 290 wells would be drilled, resulting in an estimated 986 acres of new disturbance on public land. This surface disturbance would result in a short-term increase in sediment and salinity in surface waters, and a potential increase in peak flows. The intensity and duration of these impacts would be reduced by effective mitigation including water bars for roads, siting locations and roads away from drainages, maintaining riparian buffers, and others.

4.9.1.3 Cumulative Impacts

Cumulative short- and long-term impacts to surface waters resulting from oil and gas development in Region 4 would be of the same type but greater in magnitude than the impacts to date. The impacts would continue to be minimal. Most of the area being developed is dry with runoff only occurring occasionally throughout the year. When runoff events do occur, sediment, salt, and other pollutant increases coming from oil and gas facilities are indistinguishable from those coming from undisturbed areas in the rest of the basin.

An assumed 1,200 wells would be drilled in the next twenty years in Region 4. The new wells would cause a surface disturbance of an estimated 4,080 acres. Approximately 1,020 acres of public land and 3,060 acres of private land would be disturbed. This surface disturbance would result in a short-term increase in sediment and salinity in surface waters and a potential increase in peak flows. The intensity and duration of these impacts would be reduced by effective mitigation including water bars for roads, siting locations and roads away from drainages, maintaining riparian buffers, and others.

4.9.2 Groundwater

4.9.2.1 Impacts to Date

No noticeable impacts on BLM-managed mineral estate have occurred. However, in September, 1997, a well being drilled on private mineral estate in T.7S., R.94W., sec. 4, encountered a gas "kick," which resulted in an underground blowout. It resulted in contamination of a private water well located about 3,800 feet to the northwest. The operator is conducting a sampling project in the vicinity of the contaminated well to determine the extent of contamination and to monitor water quality changes (Maxxim, 1998). A nearby replacement well and six observation wells about 500 feet away were drilled. Initial results indicate elevated benzene and methane levels, which were reported at 0.4 and 12.6 mg/l, respectively, in the

replacement well. However, since the initial readings, biodegradation appears to have significantly lowered the concentrations of benzene. There is no additional information on the methane levels. Sampling of 20 other domestic wells in the vicinity indicate that no other wells were impacted. Except for this incident and the replacement and observation wells, there has been no known contamination of any other water wells as a result of gas drilling operations in the area.

Due primarily to this incident, the COGCC has identified an area consisting of 31 sections in T.6 & 7S., R.94W. in the Rulison Field as being more fractured and having higher pressures than normal for the region, requiring special consideration. New wells located within this "overpressured area," that are drilled to the Williams Fork Formation, are now required to have surface casing set to a depth of 1,100 feet. This depth allows the operator to better manage the gas pressures. In addition, the lower part of the surface casing should be set into more competent rock. Also in response to this incident, the COGCC required leak-off tests to be conducted on all Williams Fork wells outside the overpressured area. This procedure is a pressure test to determine the integrity of the surface casing show and the first identifiable sand encountered below the surface casing shoe. Based on an evaluation of these tests, surface casing on Williams Fork wells outside of the overpressured area must be set at a minimum depth of ten percent of the total depth of the well.

In the Rulison Field, the gas production zone is generally at least 5,000 feet below any usable water zones plus the surface casing is cemented across any shallow water zones. Within the overpressured area, new wells should now be buffered by at least 800 feet of strata between the base of the surface casing and the lowermost aquifer.

The COGCC also requires Bradenhead pressure testing access to the annulus in certain circumstances. This allows the gas pressures to be monitored for possible leaks, on an as required basis. Moreover, although the Wasatch G Sands are not producible, BLM also requires cementing and isolating across these zones because they do contain some gas.

4.9.2.2 Future Impacts

Little impact to groundwater resources is anticipated from BLM-approved gas drilling operations under all alternatives. BLM, Colorado Oil and Gas Conservation Commission (COGCC), and operators all implement procedures to protect the groundwater resource. As additional information becomes available, current drilling and completion techniques will continue to be evaluated and modified as necessary to assure continued protection of the groundwater resource. BLM procedures prior to APD approval include a groundwater review by a geologist, and require that any shallow water zones and aquifers be isolated and protected behind cemented surface casing. This creates an impermeable barrier between the casing and the hole wall (annulus) which prevents migration of gas and fluids into any water zones.

Additionally, all usable water zones encountered below the surface casing and all prospective gas zones, including the Wasatch G Sands for public lands, are required to be isolated and protected with cement. Based on the depth of the water wells and thickness of the alluvium and other surficial deposits, most of the gas wells drilled in the past within this region have been set with 300 to 600 feet of surface casing, with the base of the surface casing set into bedrock in the Wasatch Formation. The surface casing is therefore set through the water zones offering protection from the drilling operations.

In December, 1997, in response to the September "kick" incident, COGCC issued a Notice to All Operators, regarding additional measures to protect groundwater during drilling and completion operations in the William Fork Formation wells in Garfield County. COGCC

continues to evaluate requirements for adequate surface casing depths. Additionally, COGCC has issued a contract for the analysis of 111 wells to date and for an additional 45 wells during the spring of 1998 in order to provide baseline water quality information throughout the region

Since domestic water wells are located on private lands, there is a lowered potential for impacts to water wells from operations on public lands, except on split estate lands (private surface/ Federal minerals), where domestic wells may be found. The highest potential for impacts in the region is probably within the Porcupine Creek area because the area includes Federal mineral estate within the overpressured area with high levels of gas well development and overlaps areas favorable for containing usable groundwater.

In summary, the overall potential for contamination of usable water zones and domestic water wells from operations on public lands is considered to be very low. This conclusion is based on several factors: the small number of domestic wells and the limited exposure of water-bearing zones on public lands; the existing and updated requirements for isolating ad protecting usable water zones; and testing and monitoring requirements as needed.

4.10 Forestry

This discussion supplements the existing impact discussion presented in the FEIS on page 4-15.

Outside Region 4 the effect on forest types would be minimal, considering the low level of present and projected oil and gas development. The expected loss of Pinyon/Juniper or Oak woodlands from oil and gas access road and wellpad construction within Region 4 is relatively minor when compared to the extensive amount and distribution of the woodland types. Future impacts under all alternatives are expected to be similarly minor in nature and extent.

4.11 Recreation

4.11.1 Impacts to Date

Impacts are limited to Region 4, and include changes in the character of the setting in some dispersed recreation areas where new roads and well sites have been developed. Most of these areas lack public access, with the exception of Porcupine Creek basin.

4.11.2 Future Impacts

4.11.2.1 Current Management Alternative

Recreation values would be protected by the NSO stipulation on public lands in the special recreation management areas and ACECs, including the Upper Colorado and Eagle rivers, Hack Lake, Deep Creek, Bull Gulch, Thompson Creek and around Sunlight Peak. Additionally, recreation values found in the WSAs would be protected by the no leasing status of those areas, at least during the period of interim wilderness management. Non-motorized recreation values in places outside these areas may be affected by road construction if gas development occurs within them.

4.11.2.2 Maximum Protection Alternative

Recreation values in the SRMAs, ACECs and WSAs would be protected by the NSO and no leasing status. Adverse impacts from gas development would be minimized in areas managed under non-motorized recreation objectives in the Pisgah Mountain, Castle Peak, King Mountain, Siloam Springs and Haff Ranch would be protected by a NSO aimed at protecting non-motorized values. Other areas with non-motorized values, but not managed for

those values, may be affected by road construction if gas development occurs within them.

4.11.2.3 Proposed Action

Areas with semi-primitive non-motorized recreation management objectives would be protected by a NSO. Impacts would be similar to those under the maximum protection alternative.

4.12 Visual Resources

4.12.1 Impacts to Date

The visual impact to date was evaluated by analyzing the visibility and visual sensitivity of the locations of wells and related access roads. Gas development features in areas that are moderately to extremely visible are potentially noticeable from a wide-ranging area, and may contribute to changes in the character of the landscape in a given area. Gas development sites in areas that are seldom seen or which receive low visibility are likely to be noticed from relatively few places, and consequently have limited, localized visual impacts. Some wells on National Forest system lands are in locations visible from the key viewing areas, but viewing distance is over 15 miles away and their visual impact is not discernible due to local screening.

The visual impact of gas development activities generally depends on the character of the landscape and the visual contrast of modifications to the landform and vegetation features, and the size, color and shape of structures. During gas well drilling operations, newly constructed pads and roads with bare cut and fill slopes are noticeable and attract attention. The drilling derrick and related equipment, flaring operations and associated traffic also attract attention and are noticeable from a distance. Most drilling equipment is painted white or some other light color that stands out, and the sites are usually brightly lit at night. After drilling and during well production, visual impacts mainly consist of the pad, access road and associated cut and fill slopes, tank batteries and meter shacks, and in some cases above-ground pipelines. Visual impacts after a well is abandoned are mainly related to the ground disturbance from regrading the pad site and road to roughly original contours, if that is done. If the wells are abandoned without recontouring, visual impacts would be mainly from the platform and any cut and fill slopes.

The visual impact of wellpad and access road construction is greatest on sloping ground, with the size of the total disturbance depending on the ground slope and the steepness of the cut and fill slopes. Grading of a flat area approximately 200 by 300 feet for a typical pad is required to accommodate drilling operations. On flat ground, a drilling pad may disturb about 1.5 acres while on 40 percent slopes it can disturb up to 5 acres if the cuts are at the desirable 2½:1 to 3:1 slope. Earthwork in areas where the subsoil color contrasts highly with the ground surface color is readily noticeable even at great distances and is likely to attract attention. Grading also creates new lines and surfaces of different aspects, and different surface textures which contribute to the visual impact.

Vegetation clearing required for wellpad, road and pipeline construction creates openings or swaths through the cover. Generally, in all vegetation types, the visual impacts of clearing are most noticeable in the first five years after construction when the revegetated cover and natural types differ most. Visual contrast of clearings is greatest in the dark colored vegetation types with dense cover where the changes in type, colors and edges are high and sharply defined. Wellpads and roadsides on public lands are supposed to be revegetated under lease stipulations, typically with grasses and forbs which contrast sharply with shrub and tree cover types because of their smaller scale, lighter colors and finer texture. The visual contrast of

revegetated areas attenuates as shrub cover becomes established over time. The time it takes for revegetation to blend in with surrounding vegetation depends on site conditions and the success in getting anything to grow. Poor soil conditions and steep cut and fill slopes usually result in poor revegetation and longer lasting visual impacts.

In a producing field, ancillary facilities such as pumping and compressor stations also cause visual impacts that are noticeable and attract attention. These facilities can be large and occupy several acres, and can be seen along I-70 west of Rifle. Painting structural features with flat finish and colors which blend with surroundings helps reduce their visual impact and is used successfully in some well production facilities. The visual impact of current gas development in each of the viewsheds is summarized below.

Battlement Mesa Views. Of the 66 potentially visible well sites, 14 are on BLM and 13 on NOSR Production Area lands; 39 are on private land. Of the total, 53 are in highly sensitive locations and 27 are in a VRM Class II area. Some have noticeable visual impact but few attract attention. Viewing distance is 2 to 5 miles which reduces the scale of the visual impact, and the landscape is highly textured by local relief and sparse vegetation, tending to screen and attenuate the visual contrast. The wells that are noticeable are in dense woodland on terraces northeast of Parachute and the clearings for roads and pipelines are highly visible. Some gas development sites exceed BLM's VRM objectives.

Highway 13 Views. Of the 37 potentially visible sites, 5 are on BLM, 16 are on National Forest lands, and the remainder on private land. Four of the sites are in highly sensitive locations but they are in VRM Class IV area. However, their visual impact is not noticeable due to viewing distance ranging over 3 to 5 miles and local screening. Overall, VRM objectives are being achieved.

Holms Mesa Views. Of the 110 well sites potentially visible from Holms Mesa, 17 are on BLM, 18 on NOSR Production Area lands, and 75 are on private land. Seventy -one of the total are in highly sensitive locations and 28 are in a VRM Class II area. Most are located in the sagebrush and greasewood parks along I-70 and the surrounding slopes. The visual contrast of many of these wells is high and they are noticeable and attract attention. Viewing distance to most of the well sites is from 2 to 5 miles, with a few wells visible at less than a mile away. Due to the elevation of Holms Mesa many of the well sites are seen from above, increasing the visual impact of the pads, roads and pipeline clearings particularly in the Sharrard Park area. Development in the Sharrard Park area exceeds VRM objectives.

Interstate 70 Views. Of the 182 well sites potentially visible along I-70, 19 are on BLM, 13 are on NOSR Production Area lands, a few are on Forest Land and 145 are on private property. Of the sites on private land, 21 are on split estate. There are 162 sites in highly sensitive locations and 83 in VRM Class II areas. Most of these wells are found along the 10 mile stretch between Parachute and Rifle, with the most noticeable concentrations around Webster Mesa and Sharrard Park. Landform and vegetation characteristics screen or buffer the visual impact of wells that are far from the highway, but the visual contrast of many wells in the foreground attracts attention, particularly in the open sagebrush and greasewood parks and dense PJ woodland on slopes facing the viewers. Visual impact of gas development in the foreground between Rifle and Parachute exceeds VRM objectives.

Parachute Creek Views. Of the 48 well sites potentially visible in Parachute Creek, 18, or about a third, are on BLM land and the rest are on private land. Of those on private land, 3 are on split estate. All sites but one are in highly sensitive locations and 18 are in VRM Class II areas. Most of the wells are in a 5 mile stretch from the town of Parachute to Starkey Gulch on

the west slope below Mount Callahan. Viewing distance varies from 0.1 to 1 mile. Local topographic and vegetation texture tends to screen or attenuate the visual impact, and most of the wells away from the county road are not noticeable. Overall, current VRM objectives are being achieved.

Rifle Views. Of the 38 potentially visible well sites, 6 are on BLM, 12 are on National Forest land, and the rest are on private land.. Nine are in highly sensitive locations and 3 are in a VRM Class II area. Most of these wells are in the vicinity of Webster and Taugenbaugh mesas. Viewing distance to the closest sites is 1 to 5 miles away and their visual impact is not noticeable. A gathering pipeline on private land on the mesa slope just south of town is noticeable and attracts attention. Overall, current VRM objectives are being achieved.

4.12.2 Impacts of Future Development

4.12.2.1 Continuation of Current Management Alternative

With the assumed gas well development and a continued pattern of well site locations, all of the viewsheds will be affected by a noticeable increase in visual impacts from gas development. Visual impacts of development under new leases in the NOSR Production Area in the I-70 viewshed would be reduced by the existing CSU stipulation on VRM Class II areas. Visual impacts of development under existing leases could be reduced by COAs applied on APDs. However, relocation necessary to reduce visual impacts would be limited to less than 200 meters, and visual impacts would be unavoidable in some locations. The possible visual impacts in each viewshed are summarized below.

Battlement Mesa Views. Of the potentially visible well sites, 35 might be on BLM and 33 on NOSR Production Area lands, and 98 on private land. Approximately 165 well sites may occur in the Battlement Mesa viewshed, with about 133 in highly sensitive locations and 68 in the VRM Class II areas. Potential wells in the denser PJ woodland will be the most noticeable, particularly on the side of High Mesa and on the terraces around Parachute, and exceed VRM objectives. The visual impact of many of the wells is likely to be attenuated by terrain and vegetation conditions.

Highway 13 Views. Of these well sites, 13 might be on BLM, 40 on National Forest lands, and the rest on private land. Approximately 93 well sites might be visible from Highway 13, with about 10 in highly sensitive locations and a few in the VRM Class II areas. The visual impact of most of these wells is not likely to be noticeable due to far viewing distance and screening. Overall, VRM objectives are likely to be achieved for this viewshed.

Holms Mesa Views. Of the approximately 275 well sites that might be visible form Holms Mesa, about 43 are likely to occur on BLM, 45 on NOSR Production Area lands, and 88 on private land. Perhaps 178 would be in highly sensitive locations and about 70 in VRM Class II areas. Many of these wells will be noticeable and attract attention and are likely to exceed VRM objectives, particularly in the Sharrard Park area.

Interstate 70 Views. Of the approximately 455 well sites potentially visible along I-70, about 48 might occur on BLM, 33 on NOSR Production Area lands, and 363 on private property. Of those on private land, 53 may occur on split estate. About 405 might be highly sensitive locations and 208 in VRM Class II areas. The concentration of visual impacts will increase and be most noticeable in the stretch between Rifle and west of Parachute. The visual impact of gas development in the foreground west of Rifle will change the character of the scenery from rural agricultural to a gas field.

Parachute Creek Views. Of the approximately 120 potentially visible well sites, 45 may occur on public land with the rest on private land and about 8 on split estate.. About 118 could be in highly sensitive locations and 45 in VRM Class II

areas. Many of the new wells are likely to be screened or buffered by local topographic and vegetation conditions, but some are likely to be noticeable and attract attention.

Rifle Views. Of the approximately 95 well sites potentially visible from Rifle, 16 may occur on public land, 30 on National Forest land, and the rest on private land. About 23 could be in highly sensitive locations and 8 in VRM Class II areas. The visual impact of most of them is not likely to be noticeable due to great viewing distance and screening or buffering by landscape features. Development on the slopes below Flatiron Mesa south of town would be the most likely to exceed VRM objectives.

4.12.2.2 Maximum Protection Alternative

The visual impact of assumed gas development under new leases would be minimized by the NSO stipulation on visually sensitive slopes over 25% in the I-70, Battlement Mesa, Holms Mesa, Rifle and Highway 13 viewsheds. Visual impacts would also be reduced by the CSU stipulation on visually sensitive lands under 25% slope within these same viewsheds. The scale of the landscape modifications from well pad and road construction would be reduced and modifications would be prevented on the most sensitive landscape features on public land, but the visual impact of gas development will be noticeable nevertheless, particularly in the immediate foreground views. Some of the visual impact of gas development under existing leases in all of the viewsheds would be reduced by efforts to address visual concerns during the APD review process. VRM Class II objectives may be exceeded in some places.

Approximately 25 of the 70 assumed potential well sites in the Production Area would not be developed, partly because of the NSO on visually sensitive slopes.

4.12.2.3 Proposed Action

The visual impact of gas development under new leases would be minimized by the NSO stipulation on visually sensitive slopes over 25% in the I-70 viewshed, and by the CSU stipulation on lands under 25% slope in all the key viewsheds (I-70, Battlement Mesa, Holms Mesa, Rifle and Highway 13). Some of the visual impact of gas development under existing leases would be reduced during APD review. VRM Class II objectives will be exceeded in some places.

Approximately 15 of the 70 assumed potential well sites in the Production Area would not be developed, partly because of the NSO on visually sensitive slopes.

4.12.3 Cumulative Impacts

Visual impacts of gas development on public lands and non-public lands in Region 4 will continue to become more noticeable as new roads and well sites are developed. The impacts will be most noticeable in the foreground-middleground views. In areas of concentrated development, the character of the existing landscape will be affected by noticeable modifications that will degrade the natural scenic quality. Mitigation efforts on public land will reduce visual impacts on the most sensitive landscape features. However, VRM Class II objectives are likely to be exceeded in some places, particularly by development on existing leases. However, VRM Class II objectives are likely to be exceeded by development on existing leases due to valid existing rights.

Visual impacts of future gas development on private lands will contribute the most to the change in the character of the landscape along I-70 in Region 4, with wellpad, road and pipeline construction likely to be noticeable and attract attention.

Operations on BLM lands will be more a factor in changes to landscape character in other viewsheds. Since most of Region 4, except the NOSR Production Area, is leased without

stipulations specific to visual resources, BLM will have a much more difficult time in achieving VRM objectives for those areas. Development, both residential and commercial, of private lands will be an important factor in these areas as well.

With the proposed mitigation, future gas development on the NOSR Production Area will be generally consistent with VRM Class II objectives for the I-70 viewshed, but there may be instances where construction of an individual wellpad or access road will exceed visual contrast limits for this VRM class. In these instances, the visual impact will contribute only slightly to the overall change in the landscape character given the predominant influence of the development of private lands on the landscape.

4.13 Cultural Resources

Direct effects are held to a minimum by identifying cultural resources early in the planning process. Early identification is accomplished by conducting a record search and intensive (Class III) ground survey of any areas of potential effect prior to the issuance of any permit. In most cases, the project can be planned to avoid affecting the resource.

In those few cases where a significant resource cannot be avoided, a mitigation plan must be developed with the Authorized Officer and, in the case of cultural resources, the State Historic Preservation Officer. Mitigation is expensive and can be time consuming. The costs of mitigation are borne by the project proponent. Mitigation may involve the relocation of the disturbance in excess of 200 meters or excavation, recording and analysis of the cultural resource. Site excavation is a destructive form of mitigation and is done only if preservation is not possible.

Buried cultural resources may not be detected until the development has begun. Disturbance in deep alluvial soils or near significant sites shall be monitored. If any cultural materials are noticed at anytime, the authorized officer must be notified so the resource can be recorded, evaluated, stabilized, or mitigated. Work in the area of the discovery should stop until notified by the AO to proceed.

Indirect impacts occur when secondary activities affect cultural resources. For example, opening a road may result in increased recreational use, which could lead to unauthorized collection or vandalism of cultural resources. Changes in drainage patterns, erosion or altered livestock movements by construction or modification of fencing might also lead to site impacts. Indirect impacts are minimized by the use of gates on newly constructed roads to minimize traffic into an area, educating industry workers and subcontractors about the importance of leaving cultural resources in place, and erosion control measures.

Beneficial impacts of development include increased inventories of acreage and sites as prescribed in Section 110 of the National Historic Preservation Act. The increased inventory and recording may improve the understanding of the history and prehistory of the region. Avoidance and protection of significant sites will continue. Identified sites can be better managed and protected than unknown sites.

The Northern Ute, Southern Ute and Ute Mountain Ute have been asked to express any concerns during the development of this supplemental environmental impact statement. When traditional cultural properties or sacred sites are identified within areas of potential development, the sites will be avoided whenever possible. In cases where there may be an effect on a traditional cultural property or sacred site, consultation will be carried out with the Ute tribes to identify acceptable alternatives.

4.13.1 Impacts to Date

Direct impacts have been minimal because of the consistent application of the prescribed identification, avoidance and mitigation

measures. It is uncertain to what extent indirect impacts have occurred because little evaluation has been done. The risk of indirect impacts can be minimized by managing access and through education.

4.13.2.1 Continuation of Current Management Alternative

Under the Continuation of Current Management Alternative, direct impacts will continue to be minimal because of consistent application of the prescribed identification, avoidance and mitigation measures. Indirect impacts would be minimized by managing newly developed access and through education of industry workers about the importance of leaving cultural resources in place. The Archaeological ACEC, sacred sites, and the wickiup village are protected by law and the Standard Terms and Conditions, but have no specific stipulation providing further protection.

4.13.2 Impacts of Future Development

4.13.2.2 Maximum Protection Alternative

The MPA is the same as the Continuation of Current Management Alternative and would have the same impacts.

4.13.2.3 Proposed Action

The Proposed Action is the same as the Continuation of Current Management Alternative and would have the same impacts.

4.14 Paleontological Resources

Direct effects are held to a minimum by identifying paleontological resources early in the planning process, and treating the resources as described in the BLM manual and the BLM Handbook on Paleontological Resources, H8270-1. Prior to authorizing surface disturbing activities, the BLM makes a preliminary determination as to whether potential exists for the presence of fossil material. If potential exists for the presence of valuable fossils, a paleontological survey will be required. Class I and, in some cases, Class II formations are inventoried for fossil localities early in the planning process. In most cases, the project can be planned to avoid affecting the resource. In those few cases where a significant resource cannot be avoided, a mitigation plan must be developed with the AO. Mitigation is expensive and can be time consuming. The costs of mitigation are borne by the project proponent. Mapped fossil sites will be protected by applying the appropriate mitigation to the use authorization. Mitigation may involve the relocation of disturbance or excavation and recording of the fossil remains. BLM determines the disposition of any fossils discovered and excavated.

Certain areas may require the presence of a qualified paleontologist to monitor operations during surface disturbing activities. Buried paleontological resources may not be detected until the development has begun. If any fossils are noticed at anytime, the AO must be notified so the resource can be recorded, evaluated, stabilized, or mitigated. Work in the area of the discovery should stop until notified by the AO to proceed.

Indirect impacts occur when secondary activities affect paleontological resources. For example, opening a road may result in increased recreational use, which could lead to vandalism of paleontological resources. In addition, changes in drainage patterns, erosion or altered livestock movements by construction or modification of fencing might lead to impacts. Indirect impacts are minimized by the use of gates on newly constructed roads to minimize traffic into an area, educating industry workers and subcontractors about the importance of leaving paleontological resources in place, and erosion control measures.

Inventory has beneficial impacts for fossils by identifying, recording, and evaluating an increased number of fossil localities. The increased inventory and recording may improve

the understanding of the paleontology of the region. Avoidance and protection of significant sites will continue. Identified sites can be better managed and protected than unknown sites.

4.14.1 Impacts to Date

Impacts have been minimal because of the consistent application of the prescribed identification, avoidance, and mitigation measures. It is uncertain to what extent indirect impacts have occurred because little evaluation has been done. The risk of indirect impacts can be minimized by managing access and through education.

4.14.2 Impacts of Future Development

4.14.2.1 Continuation of Current Management Alternative

Under the Continuation of Current Management Alternative the Sharrard Park Fossil Localities are protected by the Standard Terms and Conditions, but have no specific stipulation providing further protection. Direct and indirect impacts could occur to the Sharrard Park fossils. Due to the high density of paleontological localities in the Sharrard Park, the sites might be impacted even if well pads are relocated 200 meters away.

4.14.2.2 Maximum Protection Alternative

Under the Maximum Protection Alternative, a NSO stipulation would apply to the Sharrard Park paleontological resources. Since the area is already leased and under development, compliance with the stipulations would be voluntary.

4.14.2.3 Proposed Action

The Proposed Action is the same as the Continuation of Current Management Alternative and would have the same impacts.

4.15 Wilderness

4.15.1 Impacts to Date

To date, no impacts to wilderness resources have occurred from oil and gas development. There are no current leases within any of the WSAs or on adjacent lands, and no exploration or development has taken place since the early 1980's when seismic work was conducted in the Castle Peak WSA. No impacts have occurred on the Conservationists' proposed wilderness areas either.

No review for "roadlessness" on the 56,000 acres of NOSR lands was completed. While the bill transferring the NOSR lands to BLM mandated that certain lands be leased for oil and gas within one year and that the remaining lands be offered as soon as practicable, the bill also established that the lands be managed consistent with the Federal Land Management and Policy Act (FLPMA) of 1976. FLPMA directed that wilderness values be inventoried and considered in a land use planning process. Accordingly, an informal assessment of the impacts of the existing road system against the "roadless" criteria was completed to determine if a comprehensive inventory of wilderness values should be conducted prior to leasing.

A preliminary inventory of all roads constructed or maintained on the NOSR was prepared and is available at the GSRA office. While this road system is extensive, it is possible to "cherry stem" around many of these roads and identify several areas greater than 5,000 acres that need additional consideration against the roadless criteria. BLM has proposed to complete this evaluation at a later date when a separate management plan for most of NOSR 1 and portions of NOSR 3 outside the Production Area is completed.

Within the 12,000 acre NOSR Production Area, numerous roads exist, mostly to facilitate oil and gas development by the DOE or to accommodate the oil shale experiment facility at

Anvil Points. However, by "cherry stemming" around these existing roads, it is possible to identify at least a portion of the NOSR Production Area as potentially meeting the roadless criteria.

Of that 12,000 acres, nearly 6,000 acres is considered developed because it contains roads, pipelines, and wells and/or is included in several communitization agreements. This portion of the NOSR Production Area would not likely meet roadless criteria. Most of the anticipated future development in the NOSR Production Area would occur in the general vicinity of the area already developed. The remaining, unroaded portion of the NOSR Production Area is steep, in fact, the Roan Cliffs and adjacent foothills essentially represent the undeveloped portion. Almost 70% of the entire NOSR Production Area would be affected by an NSO restricting development on slopes greater than 35%.

Given that BLM intends to offer for lease less than 25% of the NOSR at this time, that 50% of the lands to be leased are developed and would not meet roadless criteria, that much of the future development will be in the vicinity of the current development, and that much of the undeveloped portion of the area to be leased is greater than 35% and would be protected with an NSO, little impacts to potential roadless areas are expected. Therefore, a roadless review is not needed at this time and BLM will not conduct a roadless review of the NOSR Production Area prior to leasing.

values. It is unlikely that lease tracts would be proposed in those areas due to the relatively low mineral potential.

4.15.2 Impacts of Future Development:

4.15.2.1 Continuation of Current Management Alternative

No impacts to wilderness resources are expected during interim wilderness management of the WSAs. Congressional wilderness designation of portions of the Bull Gulch WSA and the Hack Lake and Eagle Mountain WSAs would preclude leasing. Areas released by Congress for uses other than wilderness would be leased according to stipulations in effect at the time of leasing. No protective stipulations exist on the portion of the Bull Gulch WSA not recommended by the BLM for wilderness designation. Impacts of oil and gas development in the Castle Peak WSA would be reduced by the VRM Class II CSU stipulation but if development occurs it would result in a loss of natural and semi-primitive non-motorized recreation values.

Should lease tracts be proposed by industry on lands within the conservationists' proposed 'add-on' wilderness areas, the review process required by current Colorado BLM policy would be initiated to determine if those lands contain wilderness values and whether the RMP should be amended to consider protection of those

4.15.2.2 Maximum Protection Alternative:

Impacts to wilderness resources under this alternative would be the same as under current management, except that a NSO stipulation would protect natural and semi-primitive non-motorized recreation values in the lands within the WSAs, recommended for release by Congress for uses other than wilderness.

4.15.2.3 Proposed Action

Impacts to wilderness resources under this alternative would be the same as under the maximum protection alternative.

4.16 Lands and Realty Actions

The Environmental Consequence section for Lands and Realty Actions is found in the FEIS on page 4-20. No further discussion is necessary in this document.

4.17 Transportation

This section replaces the description of the effects of new road construction for oil and gas development found in the FEIS on pages 4-20 and 4-21.

Oil and gas development commonly includes the construction of new roads to access wellpads. Newly constructed roads are the source of much of the impact related to oil and gas development. They make up a major part of the surface disturbance and represent the largest part of the long-term commitment of the soil resource, as roads are often not rehabilitated but left in place. The disturbance created by the road construction could alter the viewshed. Road construction often occurs in or near riparian areas, sometimes crossing streams; this could affect the operation of riparian systems and the quality of surface water. The motor vehicle access provided by new roads increases human activity and traffic in areas that might previously have seen little human activity, potentially resulting in secondary impacts on wildlife, cultural and paleontological resources and on recreation opportunities.

Well drilling rigs and support equipment travel from site to site and may affect local traffic patterns, damage roads, and create safety problems. This issue is primarily related to county roads, under the jurisdiction and control of Garfield County. County roads tend to be narrow, winding roads, designed for farm-to-market, light-volume, light-duty traffic. Oil and gas equipment travelling on these roads often exceeds the designed capacity of the roads, creating safety issues and requiring extra maintenance. There may be substantial new costs for the county associated with this degree of road maintenance.

BLM's road construction standards are applied in the design of access roads. These standards have proven to be effective in mitigating soil erosion problems related to disturbance from construction operations. Actions such as limiting road grades, providing proper water drainage including ditches and culverts, applying surface materials such as gravel, avoiding excessive earthwork and sidecast of materials, and implementing dust abatement techniques can effectively mitigate adverse impacts. BLM requires that the operator obtain all necessary local permits, including the hauling permits required by Garfield County.

If a producing well is found, the road is generally maintained periodically by the operator to provide year-round vehicle access to the site. Maintenance actions such as surface blading, culvert and ditch cleaning, spot surfacing and weed control are required to ensure that road standards are recognized and resource impacts are minimized. In instances when a well is plugged and abandoned, BLM usually requires the rehabilitation and closure of roads related to the site unless overriding benefits to the public dictate that a road remain open for travel. Appendix I, Reclamation, summarizes the disturbance related to wellpad and road development on BLM-administered mineral estate and the subsequent reclamation efforts.

When road development results in improved vehicle access to areas with important resource values which could be adversely affected by motorized users, BLM may require the operator to restrict access to administrative users (BLM and its lessees or permittees) by installing traffic controls such as locked gates. This action may adversely affect the public motorized user.

4.17.1 Impacts to Date

BLM. An assessment was conducted and found that 57 miles of roads have been specifically constructed for oil and gas development on public lands. This is about 3 percent of the estimated total 2,025 miles of road in Region 4. About 60 percent of the 57 miles were built on public lands and the remaining 23 miles were constructed on private lands, including split estate holdings. This represents 0.36 miles of

new road on average for each of the 160 wells drilled on public mineral estate.

An effective method for evaluating the effect of roads in an area is to calculate road densities. The miles of road per square mile in a given area serve as an indicator of the amount of development-related impact that has occurred. Map 4.17-1 displays the road densities in Region 4 and the contribution to density made by development of gas resources on public mineral estate. Road density was calculated by totaling all roads within a section of land and dividing the total miles by the square miles within a section. (The solid gray shades on Map 4.17-1 represent road density categories within Region 4 for all existing roads.) Additionally, roads specifically constructed for oil and gas development on BLM land or mineral estate were totaled, and road densities were calculated for these roads. (The stippled boxes overlaying the gray shades represent the effect of road density contributed by oil and gas development on BLM or BLM mineral estate). The primary area affected by new oil and gas roads on public land lies west and north of Parachute and Rulison, with isolated concentrations located in Porcupine Creek, Mamm Creek, Dry Creek, and Holms Mesa. In those areas road densities have increased.

Cumulative. Assuming that gas wells drilled on fee lands required, on average, the same amount of new road construction that wells on federal mineral estate required (0.36 miles per well), then the 540 fee wells resulted in the construction of 194 miles of new road. The assumed 194 miles represent about 10 percent of the total estimated road distance in Region 4. This is an overestimate since the roads built for fee wells are not included in BLM's road database. Because the roads for fee wells have not been identified and mapped, it is not possible to calculate where or to what degree, gas well roads have increased road density in any particular area.

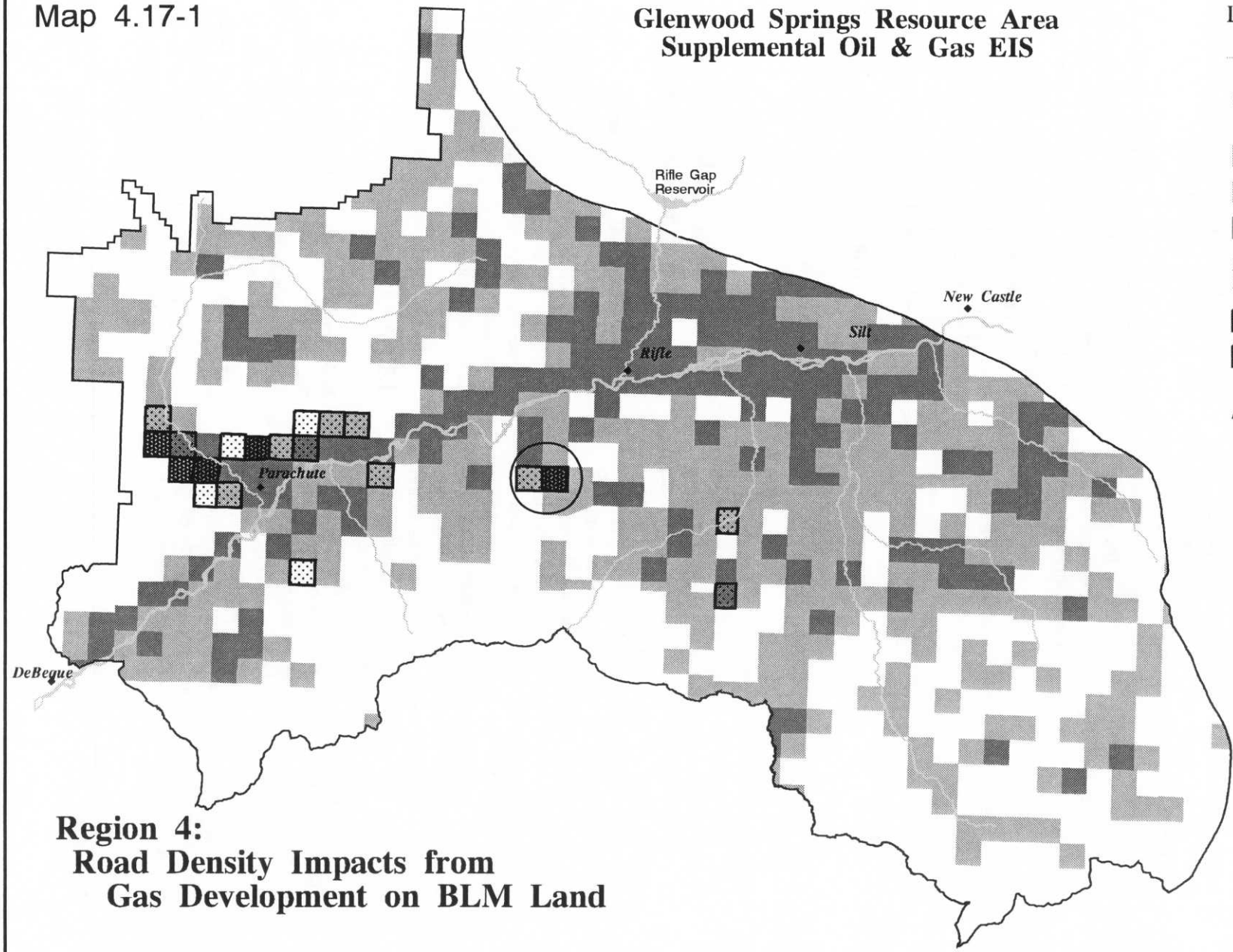
Traffic increases on many County roads and State/Federal highways because of oil and gas development. Assuming an average of four miles travelled round-trip to a well, 271 round-trips are possible during drilling operations (rig-up, drilling and rig-down) and an estimated 278 round-trips are possible for completion and testing work. These round-trips are conducted by vehicles ranging in weight from 20,000 to 110,000 pounds. For a well with an average 4 miles round-trip, 904 miles are typically traveled by 20,000 pound vehicles, 432 miles are traveled by 44-48,000 pound vehicles, 88 miles are traveled by 60,000 pound vehicles, and 56 miles are traveled by vehicles in excess of 74,000 pounds. Given the amount of trips at these load ratings, and considering the added impacts related to seasonal weather effects on road surfaces, the cumulative impact on roads and highways from oil and gas development is considerable.

4.17.2 Future Impacts: All Alternatives

If future well development required the same amount of new roads on average that wells to date have required, then the 300 wells assumed to be developed on BLM-administered mineral estate in the next 20 years would result in 108 miles of new road, perhaps 25 miles of that in the NOSR Production Area. To the extent that an alternative reduces the number of wells or well locations, that amount would be reduced. One-hundred eight miles of road would be a 5 percent increase over the current total distance of roads in Region 4. This is probably an overestimate of future road development. With the relatively well-developed road systems in place in most of the area of concentrated gas development, the average amount of new roads constructed for each well will probably decrease. It is expected that relatively short road spurs will be the common new road feature as most access roads have been constructed. The use of existing roads, however, can be expected to increase under any alternative, and the amount of traffic, road maintenance actions and cycles would increase concurrently.

Map 4.17-1

Glenwood Springs Resource Area
Supplemental Oil & Gas EIS



LEGEND

Rivers and Streams

Density of All Roads (Miles/Sq Mile)

- 4.0 or higher
- 2.0 to 3.9
- Less than 2.0

Density of Gas Development Roads on BLM (Miles/Sq Mile)

- 2.0 or higher
- 1.0 to 1.9

Example: Square within left of circle represents total road density of 2.8, with 1.4 miles of that total attributed to gas development roads on BLM land. Square within right of circle represents total density of 5.1, with 2.7 miles of that total attributed to gas development on BLM land.

N

0 10 Miles

Region 4:
Road Density Impacts from Gas Development on BLM Land

4.17.3 Cumulative Future Impacts

If future well development on fee lands required the same amount of new roads on average that wells on public land have required, then the 900 fee wells assumed to be developed in the next 20 years would result in 324 miles of new road. For the reasons stated above, this is probably an overestimate. Road densities will increase and the increased densities will occur in the area of concentrated development. It is not possible to estimate the degree of increase in any particular locale.

Traffic due to gas development will continue to affect roads in Region 4. On average four drilling rigs will be at work somewhere in the area, each rig requiring an estimated 549 trips at the varying vehicle weights mentioned above.

4.18 Social and Economic

All Alternatives. Employment and Income. The Reasonable Foreseeable Development (RFD) scenario anticipates an average drilling rate of 60 wells per year. This is based on the average level of activity during the last five years. Since the average level of drilling activity is not expected to change, employment in the oil and gas industry in Region 4 during the next 20 years would not change substantially. As total gas production grows, some slight increase in local overhead, production and maintenance staff may be required. To the extent that cyclic ups and downs in drilling activity occur, the number of drilling and completion crews would fluctuate. Changes in numbers of employees in this area would be moderated because a number of the individuals in these areas do not live in Garfield County. While the stipulations in each alternative may reduce somewhat the number of wells drilled on federal mineral estate, particularly in the NOSR Production Area, it is unlikely that there will be a measurable difference in the total number of people employed in Region 4. Since employment levels are not expected to change greatly, income is also expected to change little. The distribution of employee income between Mesa County and Garfield County may shift more toward Garfield County as the industry becomes more established and more employees choose to live in the area of production.

Government Revenues. Production from 1,200 new wells would be expected to produce over 92 million MCF annually by the year 2018 (COGCC, 1988). This analysis assumes that 25 percent of the new wells, 300, will be drilled on federal mineral estate and so, production of about 23 million MCF is expected annually from federal wells. At $1.70 per MCF the estimated wellhead value from federal wells is about $39 million. That would generate federal royalties (12.5 percent of wellhead value) of $4.9 million annually. Half of that amount would be disbursed to the State of Colorado for distribution according to State law. (Please see Appendix K.)

4.19 Areas of Critical Environmental Concern

The Environmental Consequences section for Areas of Critical Environmental Concern is found in the FEIS on pages 4-23 through 4-25. Additional discussion of the impacts of oil and gas development on such areas in the GSRA is included in the sections on Recreation and Visual Resource Management.

4.20 Minerals

BLM Impacts to Date. Drilling Activity. Since the 1950's, 130 wells have been drilled on federal leases in Region 4. Of those drilled, 16 have been plugged and abandoned (P&A) and 114 remain as producing wells as of December 31, 1997. Of those 114 wells, eight are dual locations (a wellpad with two well bores), meaning there are 106 surface locations on

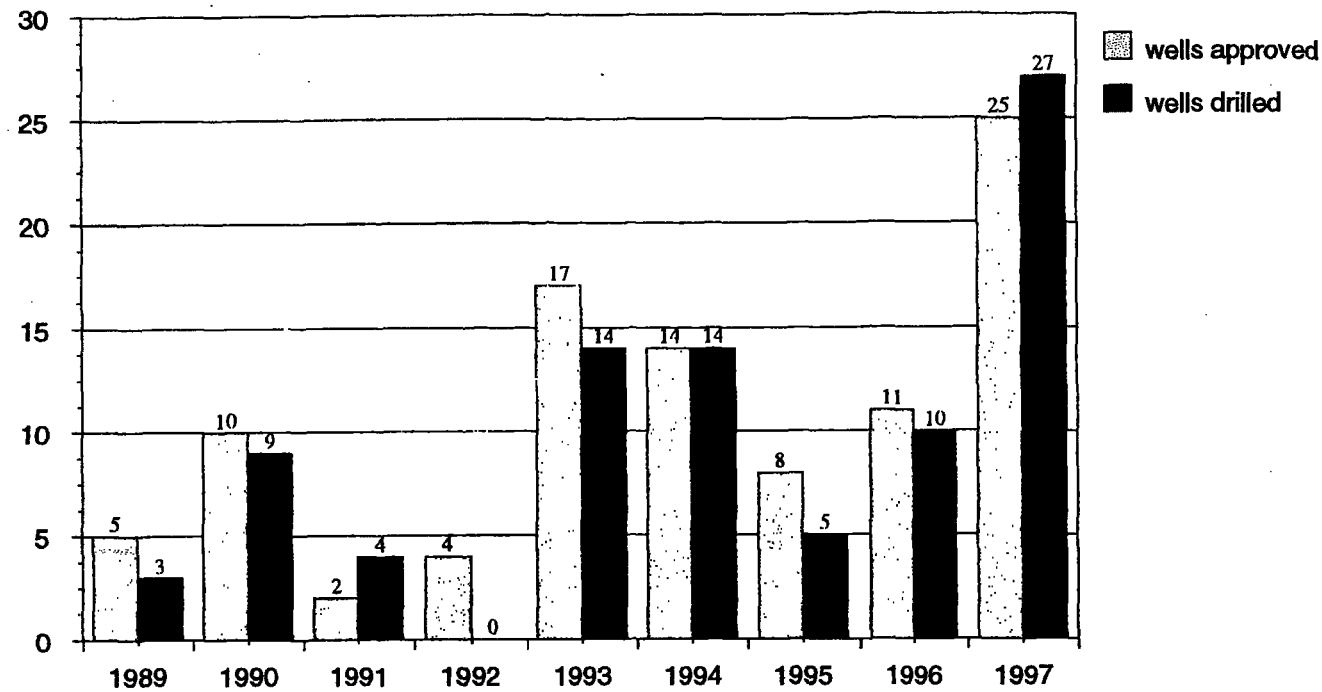
federal leases. Forty-eight of the producing wells, about 42 percent, were drilled on split estate (federal minerals, private surface).

Drilling on federal mineral estate from 1957 to 1988 was sporadic, averaging less than two wells per year. Since 1989, activity has increased, averaging about nine wells per year, a total of 84 wells. Graph 4.20-1 displays annual activity on federal mineral estate for the last nine years.

DOE began drilling in the NOSR Production Area in the late 1980's. Thirty wells have been drilled on 24 separate locations (8 of the wellpads were dual locations). One of the 30 was P&A, the remaining 29 are producing. Combining the 130 wells drilled on BLM-administered mineral estate with the 30 drilled in the NOSR Production Area, yields a total of 160 wells drilled on federal mineral estate in Region 4 of the GSRA. In general, the analyses of impacts from drilling on federal mineral estate in this document refer to all 160 wells. As necessary, occasional references to 130 wells on BLM-administered mineral estate and 30 wells in the NOSR Production Area may be made.

The number of wells approved and drilled annually on Federal mineral estate is depicted on Graph 4.20.

Graph 4.20-1 Wells Authorized and Drilled by Year (Federal Wells, Region 4)



Note: Total wells approved = 96. Total wells drilled = 86. Ten approved wells were not constructed and drilled. Wells may be drilled later than the year in which they were approved.

Following is a summary of development by designated gas field.

Grand Valley Field. Federal leases in Parachute Creek, the Grand Valley field, have been developed on 40-acre well density. A pilot program for testing 20-acre density included one well on a federal lease. Subsequently, a small area within the area on private surface and minerals was approved and is being developed on 20-acre well density. Given that development on adjacent properties is occurring on 20-acre density, future development of federal leases on 20-acre density is possible.

Rulison Field. A 40-acre density has concentrated in and around Sharrard Park and Porcupine Creek. Also within the Rulison Field, plans of development are expected for development of the Beaver Creek drainage and the Battlement Mesa/Spruce Creek areas on a 40-acre well densities.

In 1995, BLM approved a plan of development on a 40-acre density in the Garfield County landfill and will continue to be the plan for future development there. The landfill was patented to Garfield County in 1997 under the Recreation and Public Purposes Act; however, oil and gas mineral rights are held and managed by the Federal government. Additional drilling to fill in 40-acre density would continue according to the plan. A pilot program for developing 20-acre density was also approved by COGCC in 1996 for the landfill area. Two directional wells into federal minerals under the operating landfill were part of this pilot. Since the pilot program, an adjacent area has been approved and is being developed on 20-acre density.

Mamm Creek Field. The majority of the Mamm Creek Field is fee mineral estate; however, six federal wells have been drilled on 40-acre density in conjunction with adjacent private wells. Continued development on 40-acre density is expected with a majority of the federal wells on split estate.

Divide Creek Field. Three wells have been drilled on federal leases. Adjacent private property has been developed in part on 40-acre density.

Production. In 1996, gas production in Region 4 was 36,254,760 MCF. The production from 300 new wells on federal mineral estate is anticipated to be about 23 million MCF annually (COGCC, 1998). This represents somewhat less than four percent of all gas production in Colorado in 1996. Production from the NOSR Production Area would be expected to be about 5.4 million MCF.

Table 2.2-1 Wells In Region 4, 1989-97

Year	Wells Drilled			
	Total	BLM	DOE	All Fed.
1989	33	3	8	12
1990	88	9	2	10
1991	15	4	0	4
1992	12	0	4	4
1993	41	13	5	18
1994	81	14	5	19
1995	40	4	4	8
1996	53	10	0	10
1997	94	27	0	27
Total 1989-97	457	84	28	102
Average 1989-97	51	9	3	11
Total 1993-97	309	68	14	82
Average 1993-97	62	14	3	16

Cumulative impacts to date. Drilling. 700 wells have been drilled in Region 4 since drilling began in the 1950's. The 160 wells on federal estate represent about 23 percent of the total. Table 4.20-1 (this is the same as Table 2.2-1 in Chapter 2) describes drilling activity during the last nine years. Eighty-four of the total 457 drilled in the last nine years have been on BLM-administered mineral estate, about 18 percent, and 28 have been drilled in the NOSR Production Area, about 6 percent.

Production. Production from 1,200 new wells would be expected to be over 92 million MCF annually by the year 2018. This total would have amounted to about 16 percent of all gas production in Colorado in 1996 (583,990,101 MCF).

4.20.2 Future Impacts

4.20.2.1 Continuation of Current Management Alternative

The Reasonable Foreseeable Development (RFD) in this SEIS anticipates 300 additional wells drilled on BLM-managed mineral estate over the next 20 years (Chapter 2, Section 2.2). 70 of these are assumed to be in the newly leased NOSR Production Area. If half of the current number of producing wells on federal mineral estate, 143, were still producing 20 years from now, then 373 wells could be producing gas from federal reserves. Production from these 373 wells in the year 2018 could be more than 35,000,000 MCF per year. This figure assumes newer wells produce about 110,000 MCF per year and that none of the wells were shut-in.

Development on private lands will continue on 40-acre spacing and more 20 acre trials and downsizing could be expected. New COGCC cause orders for increased densities would not directly result in the same density on BLM. Densities greater than 40 acres would be reviewed on a case-by-case or in a Plan of Development to determine the impacts and containment of surface disturbance to existing 40-acre locations. Many future well proposals will likely be limited to existing 40-acre

locations and additional densities would be drilled from existing wellpads. Exceptions could be granted based on NEPA review (impacts), amount of new disturbance (i.e, use of an existing disturbance), cumulative impacts in the area and extenuating circumstances for drilling and geological conditions.

4.20.2.2 Maximum Protection Alternative

Application of more restrictive environmental stipulations would tend to reduce slightly the number of wells drilled even in previously leased areas because drilling costs would increase somewhat. Additionally, more directional wells would be drilled from dual locations, increasing the cost of drilling but also reducing the amount of surface disturbance. In particular, NSO stipulations on highly erosive soils, steep slopes, sensitive viewsheds and to maintain well site stability will make it more difficult to find suitable wellpad locations and will make their construction more costly.

In the NOSR Production Area, a decline from 70 wells to 55 would be possible as site stability, steep slope and visual constraints would result in some locations being unacceptable. In all probability, the number of locations would decrease in the NOSR Production Area, but the number of wells would not decrease as much, as more directional wells would be drilled. If the number of wells were reduced by 20 overall, annual production would be reduced by perhaps 2,200,000 MCF and access to an estimated 30 BCF of federal gas reserves would be lost or postponed.

4.20.2.3 Proposed Action

Stipulated protections under this alternative would be more restrictive than those under the Continuation of Current Management Alternative but less than the Maximum Protection Alternative. The NSO stipulation on steep slopes in this alternative will not have much effect on the number of well locations as 35 percent slope is thought to be an engineering limitation. The change from NSO to CSU for the Site Stability stipulation will make placement of wellpads somewhat less difficult. The limitation of the sensitive visual NSO stipulation to the I-70 viewshed will also make placement somewhat easier. All told, it is assumed that the restriction under this alternative will reduce the number of wells in the NOSR Production Area from 70 under the Continuation of Current Management Alternative to 65, and from 300 on all federal mineral estate to 290. The consequent loss of annual production could be about 1,100,000 MCF. Access to perhaps 15 BCF of gas reserves would be lost or postponed.

4.20.3 Cumulative Impacts

The RFD anticipates 1,200 additional wells drilled on all mineral estate over the next 20 years. If half of the current number of producing wells in Region 4, an estimated 545 wells, were still producing 20 years from now, then 1,473 wells could be producing gas in the area. Production from these wells in the year 2018 could be as much as 150,000,000 MCF, about one-fourth of the entire gas production of Colorado in 1996.

Chapter Five

CONSULTATION AND COORDINATION

5.1 Consultation and Coordination

The Bureau of Land Management (BLM) in its Glenwood Springs Resource Area, Grand Junction District and Colorado State Offices has an ongoing working relationship with the U.S. Forest Service, the Colorado Oil and Gas Conservation Commission and the Colorado Division of Wildlife. That working relationship has continued throughout the development of this document. Garfield County participated in identifying issues and potential solutions. Consultation with the U.S. Fish and Wildlife Service on Threatened and Endangered Species was initiated during the FEIS, continued through this process, and will continue throughout oil and gas development in Region 4. As described in Chapter 1, the GSRA had numerous and frequent interactions with residents of the area, and with several organized groups, in particular the Battlement Mesa Service Association and the Grand Valley Citizens' Alliance.

5.2 List of Preparers

This SEIS was produced by the following BLM Specialists listed by title, office and area of responsibility. Office acronyms are described below.

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CSO -- Colorado State Office
GJDO -- Grand Junction District Office
GJRA -- Grand Junction Resource Area
GSRA -- Glenwood Springs Resource Area
NARSC -- National Applied Resources Science Center

Chapter Six

REFERENCES

CHAPTER 6: REFERENCES

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Chapter Seven

GLOSSARY

ACRONYMS

ACEC	Area of Critical Environmental Concern
AIRFA	American Indian Religious Freedom Act
APD	Application for Permit to Drill
AQRV	Air Quality Related Values
AUM	Animal Unit Month
BEA	Bureau of Economic Analysis
BLM	Bureau of Land Management
BMSA	Battlement Mesa Service Association
BO	Barrels of oil
CDOW	Colorado Division of Wildlife
CFR	Code of Federal Regulations
CEQ	Council on Environmental Quality
CNHP	Colorado Natural Heritage Program
COA	Condition of Approval
COGCC	Colorado Oil and Gas Conservation Commission
COGEIS	Colorado Oil and Gas Environmental Impact Statement
CSU	Controlled Surface Use
DAU	Data Analysis Unit
DEIS	Draft Environmental Impact Statement
DOE	Department of Energy
DOI	Department of Interior
EA	Environmental Assessment
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FEIS	Final Environmental Impact Statement
FLPMA	Federal Land Policy and Management Act
FOOGLRA	Federal Onshore Oil and Gas Leasing Act of 1987
GIS	Geographic Information System
GSRA	Glenwood Springs Resource Area
GVCA	Grand Valley Citizen Alliance
IHICS	Integrated Habitat Inventory and Classification System
MCF	1,000 cubic feet
NEPA	National Environmental Policy Act
NOI	Notice of Intent
NOSR	Naval Oil Shale Reserves
NRHP	National Register of Historic Places
NSO	No Surface Occupancy
NTL	Notice to Lessees
NWCCOG	Northwest Colorado Council of Governments
NWPS	National Wilderness Preservation System
OHV	Off-Highway Vehicles
ONA	Outstanding Natural Area
PA	Plan Amendment
POD	Plan of Development
PSD	Prevention of Significant Deterioration
PV	Prospectively valuable
R&PP	Recreation and Public Purposes Act
RFD	Reasonably Foreseeable Development
RMP	Resource Management Plan
RNA	Research Natural Area
ROD	Record of Decision
ROW	Right-of-Way
SCS	Soil Conservation Service
SEIS	Supplemental Environmental Impact Statement
SRMA	Special Recreation Management Area
SSF	Soil Surface Factor
T&E	Threatened and Endangered
TDS	Total Dissolved Soils
TSP	Total Suspended Particulates
UMTRAP	Uranium Mill Tailings Remedial Action Project
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USLE	Universal Soil Loss Equation
VRM	Visual Resource Management
WRIS	Wildlife Resource Information System
WRNF	White River National Forest
WSA	Wilderness Study Area

GLOSSARY

ABANDONMENT. Abandonment is plugging a well, removal of installations, and termination of operations for production from a well. Conclusively, abandoned unpatented oil placer mining claims are subject to conversion into a noncompetitive oil and gas lease pursuant to the Federal Oil and Gas Royalty Management Act of 1982 (30 U.S.C. 188(f)).

AIR QUALITY CLASSES. Classifications established under the Prevention of Significant Deterioration portion of the Clean Air Act which limits the amount of air pollution considered significant within an area. Class I applies to areas where almost any change in air quality would be significant; Class II applies to areas where the deterioration normally accompanying moderate well-controlled growth would be permitted; and Class III applies to areas where industrial deterioration would generally be allowed.

ALLUVIAL SOIL. A soil developing from recently deposited alluvium and exhibiting essentially no horizon development or modification of the recently deposited materials.

ALLUVIUM. Clay, silt, sand, gravel, or other rock materials transported by flowing water. Deposited in comparatively recent geologic time as sorted or semi-sorted sediment in riverbeds, estuaries, floodplains, lakes and shores, and in fans at the base of mountain slopes.

ANIMAL UNIT MONTH (AUM). The amount of forage necessary to sustain one cow and one calf or its equivalent for one month.

ANTICLINE. A fold, generally upwardly convex, with a core containing stratigraphically older rocks.

APPLICATION. A written request, petition, or offer to lease lands for the purpose of oil and gas exploration and/or the right of extraction.

AQUATIC. Living or growing in or on the water.

AREA OF CRITICAL ENVIRONMENTAL CONCERN (ACEC). An area established through the planning process as provided in FLPMA where special management attention is required (when such areas are developed or used or where no development is required) to protect and prevent irreparable damage to important historic, cultural, or scenic values; or to fish and wildlife resources or other natural systems or processes; or to protect life and afford safety from natural hazards.

BASIN. (a) A depressed area with no surface outlet. (b) A low in the Earth's crust, of tectonic origin, in which the sediments have accumulated.

BIG GAME. Larger species of wildlife that are hunted, such as elk, deer, bighorn sheep, and pronghorn antelope.

CANDIDATE SPECIES. Any species not yet officially listed 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.

CONDITION OF APPROVAL (COA). Conditions or provisions (requirements) under which an Application for a Permit to Drill or a Sundry Notice is approved.

CONTROLLED SURFACE USE (CSU). Use and occupancy is allowed (unless restricted by another stipulation), but identified resource values require special operational constraints that may modify the lease rights. CSU is used for operating guidance, not as a substitute for the NSO or Timing stipulations.

CRUCIAL HABITAT. A biological feature, that if lost, would adversely affect the species.

CULTURAL RESOURCES. Those fragile and non-renewable remains of human activity, occupation, or endeavor reflected in districts, sites, structures, buildings, objects, artifacts, ruins, works of art, architecture, and natural features that were of importance in human events.

CULTURAL RESOURCES INVENTORY CLASSES:

<u>CLASS I.</u> An existing data survey. This is an inventory of a study area to (1) provide a narrative overview of cultural resources by using existing information, and (2) compile existing cultural resources

information, and (2) compile existing cultural resources site record data on which to base the development of the BLM's site record system.

CLASS II. A sampling field inventory designed to locate, from surface and exposed profile indications, all cultural resource sites within a portion of an area so that an estimate can be made of the cultural resources for the entire area

CLASS III. An intensive field inventory designed to locate, from surface and exposed profile indications, all cultural resource sites in an area. Upon its completion, no further cultural resources inventory work is normally needed.

CUMULATIVE IMPACTS. The collective and aggregate impacts of all actions affecting a particular resource.

DIASTROPHISM. A general term for all movement of the crust produced by tectonic processes, including the formation of ocean basins, continents, plateaus, and mountain ranges.

DIRECTIONAL DRILLING. Drilling borehole wherein course of hole is planned before drilling. Such boles are usually drilled with rotary equipment at an angle to the vertical and are useful in avoiding obstacles or in reaching side areas or mineral estate beneath restricted surface.

DIVERSITY. The relative abundance of wildlife species, plant species, communities, habitats, or habitat features per unit of area.

EASEMENT. Right afforded a person or agency to make limited use of another's real property for access or other purposes.

ENDANGERED SPECIES. Any species which is in danger of extinction throughout all or a significant portion of its range.

ENVIRONMENTAL ASSESSMENT (EA). A concise public document prepared to provide sufficient evidence and analysis for determining whether to prepare an environmental impact statement or a finding of no significant impact. It includes a brief discussion of the need for the proposal. alternatives considered, environmental impact of the proposed action and alternatives, and a list of agencies and individuals consulted.

ENVIRONMENTAL IMPACT STATEMENT (EIS). A formal public document prepared to analyze the impacts on the environment of a proposed project or action and released for comment and review. An EIS must meet the requirements of NEPA, CEQ guidelines, and directives of the agency responsible for the proposed project or action.

EXCEPTION. Case-by-case exemption from a lease stipulation. The stipulation continues to apply to all other sites within the leasehold to which the restrictive criteria applies.

FACIES. The aspect, appearance, and characteristics of a rock unit, usually reflecting the conditions of its origin; especially as differentiating the unit from adjacent or associated units,

FAULT. A fracture or zone of fractures along which there has been displacement of the sides relative to one another parallel to the fracture.

FEDERAL LAND POLICY AND MANAGEMENT ACT OF 1976 (FLPMA). Public Law 94-579 signed by the President on October 21, 1976. Establishes public land policy for management of lands administered by the Bureau of Land Management. FLPMA specifies several key directions for the Bureau, notably (1) management on the basis of multiple-use and sustained yield, (2) land use plans prepared to guide management actions, (3) public lands for the protection, development, and enhancement of resources, (4) public lands retained in federal ownership, and (5) public participation utilized in reaching management decisions.

FOLD. A curve or bend of a planar structure such as rock strata, bedding planes, foliation, or cleavage. A fold is usually a product of deformation, although its definition is descriptive and not of genetic and may include primary structures.

FORAGE. All browse and herbaceous foods that are available to grazing animals.

FOREST MANAGEMENT. The application of business methods and technical forestry principles to the operation of a forest property.

FORMATION. A body of rock identifies by lithic characteristics and stratigraphic position; it is prevailingly but not necessarily tabular, and is mappable at the Earth's surface or traceable in the subsurface (NACSN, 1983, Art. 24).

FOSSIL. The remains or traces of an organisms or assemblage of organisms which have been preserved by natural processes in the earths crust exclusive of organisms which have been buried since the beginning of historic time. Minerals, such a soil and gas, coal, oil shale, bitumen, lignite, asphaltum, and tar sands, phosphate, limestone, diatomaceous earth, uranium and vanadium, while they may be of biologic origin, are not here considered "fossils." Fossils of scientific value may occur within or in association with such materials.

FRAGILE SOIL. A soil that is especially vulnerable to erosion or deterioration due to its physical characteristics and/or location. Disturbance to the surface or the vegetative cover can initiate a rapid cycle of loss and destruction of the soil material, structure, and ability to sustain a biotic community.

GEOPHYSICS. Study of the Earth by quantitative physical methods.

GRANITE WASH TRAP. Granite wash is a sandstone formed by weathered granite basement rock. Granite is composed of coarse, sand-size crystals that weather to from a sandstone covering the flanks of buried granite mountains and hills. Source rocks occur deeper, along the flanks.

GRAZING SYSTEM. Scheduled grazing use and non-use of an allotment to reach identified goals or objectives by improving the quality and quantity of vegetation.

GROUNDCOVER. The area of ground surface occupied by the stem(s) of a range plant, as contrasted with the full spread of its herbage or foliage, generally measured at one inch above soil level.

GROWING SEASON. Generally, the period of the year during which the temperature of vegetation remains sufficiently high to allow plant growth.

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.

HYDROCARBON. Any organic compound, gaseous, liquid, or solid, consisting solely of carbon and hydrogen.

IGNEOUS. Said of a rock or mineral that solidified from molten or partly molten material.

IMPACT. The effect, influence, alteration, or imprint caused by an action.

INTERIM MANAGEMENT POLICY. Policy under which the BLM will manage lands under wilderness review until Congress either designates these lands as wilderness or releases them for other purposes. The policy applies to all Wilderness Study Areas and requires that such areas be managed in a manner so as not to impair the suitability of such areas for preservation as wilderness.

INTERMONTAINE. Situated between or surrounded by mountains, mountain ranges, or mountainous regions.

INVERTEBRATE. An animal lacking a backbone or spinal column.

KNOWN GEOLOGIC STRUCTURES (KGS). A trap in which an accumulation of oil and gas has been discovered by drilling and which is determined to be productive. Its limits include all acreage that is presumptively productive (43 CFR 3100.0.3(a)).

LAND TREATMENT. All methods of artificial range improvement and soil stabilization such as reseeding, brush control (chemical and mechanical), pitting, furrowing, water spreading, etc.

LEASABLE MINERAL. Oil, gas, sodium, potassium, phosphate, coal, oil shale, tar sands, and asphaltic materials.

LEASE. A contract in legal form that provides for the right to develop and produce oil and gas resources for a specific period of time under certain agreed-upon terms and conditions.

LEASE NOTICE. Provides more detailed information concerning limitations that already exist in law, lease

terms, regulations, or operational orders. A Lease Notice also addresses special items the lessee would consider when planning operations, but does not impose new or additional restrictions.

LEASE STIPULATIONS. Additional specific terms and conditions that change the manner in which operation may be conducted on a lease, or modify the lease rights granted.

LEASABLE MINERALS. Those minerals or materials designated as leasable under the Mineral Leasing Act of 1920. They include coal, phosphate, asphalt, sulphur, potassium and sodium minerals, and oil and gas. Geothermal resources are also leasable under the Geothermal Steam Act of 1970.

LOCATABLE MINERALS. Minerals or materials subject to claim and development under the Mining Law of 1872, as amended. Generally includes metallic minerals such as gold and silver, and other materials not subject to lease or sale (some bentonites, limestone, talc, some zeolites. etc.).

LOCATION. Perfecting the right to a mining claim by discovery of a valuable mineral, monumenting the corners, completing discovery work, posting a notice of location, and recording the claim.

LONG-TERM. Impacts occurring over a 20-year period.

MINERAL ENTRY. Claiming public lands (administered by the BLM) under the Mining Law of 1872 for the purpose of exploiting minerals. May also refer to mineral exploration and development under the mineral leasing laws and the Material Sale Act of 1947.

MINERAL ESTATE (MINERAL RIGHTS). The ownership of minerals, including rights necessary for access, exploration, development, mining, ore dressing, and transportation operations.

MINERAL MATERIALS. Common varieties of sand, building stone, gravel, clay, moss rock, etc., obtainable under the Minerals Act of 1947, as amended.

MINING LAW OF 1812. Provides for claiming and gaining title to locatable minerals on public lands. Also referred to as "General Mining Laws" or "Mining Laws."

MITIGATION. Alleviation or lessening of possible adverse effects on a resource by applying appropriate protective measures. Adverse effects can be rectified by either repairing, rehabilitating, or restoring affected environment and through compensation of the adverse effects by replacing or providing substitute resources or environments.

MODIFICATION. Fundamental change to the provisions of a lease stipulation, either temporarily or for the term of the lease. A modification may. therefore, include an exemption from or alteration to a stipulated requirement. Depending on the specific modification, the stipulation may or may not apply to all other sites within the leasehold to which the restrictive criteria applied.

MONOCLINE. A geologic structure in which the strata are all inclined in the same direction at a uniform angle of dip.

MULTIPLE-USE. Management of the various surface and subsurface resources so that they are jointly utilized in the manner that will best meet the present and future needs of the public, without permanent impairment of the productivity of the land or the quality of the environment.

NATIONAL ENVIRONMENTAL POLICY ACT OF 1969 (NEPA). Public Law 91-190. Establishes environmental policy for the nation. Among other items, NEPA requires federal agencies to consider environmental values in decision-making processes.

NATIONAL REGISTER OF HISTORIC PLACES (NATIONAL REGISTER, NRHP). A listing of architectural, historical, archaeological, and cultural sites of local, state, or national significance, established by the Historic Preservation Act of 1966 and maintained by the National Park Service.

NO SURFACE DISTURBANCE. Defined on a case-by-case basis when the activity plan for an area is developed. In general, an activity would be allowed so long as it does not interfere with the management objectives of the area.

NO SURFACE OCCUPANCY (NSO). A fluid mineral leasing stipulation that prohibits occupancy or disturbance on all or part of the lease surface in order to protect special values or uses. Lessees may exploit the oil and gas or geothermal resources under leases restricted by this stipulation through use of directional drilling from sites outside the no surface occupancy area.

NOTICE TO LESSEES (NTL). A written notice issued by the Authorized Officer. These notices implement regulation and operating orders, and serve as instructions on specific item(s) of importance within a State, District, or Area.

OFF-HIGHWAY VEHICLE (OHV). Any motorized vehicle capable of or designed for travel on or immediately over land, water, or other natural terrain.

OFF ROAD VEHICLE DESIGNATIONS. Designations of public land made through the resource management planning process pursuant 43 CFR 8340 to protect the resources of the public lands, to promote the safety of all users of those lands, and to minimize conflicts among the various uses of those lands.

Open Area. An area where all types of vehicle use is permitted at all times, anywhere in the area subject to the operating regulations and vehicle standards set forth in 43CFR 8341 and 8342.

Limited area. An area restricted at certain times, in certain areas and/or to certain vehicular use. These restrictions may be of any type, but can generally be accommodated within the following types of categories: Numbers of vehicles; types of vehicles; time or season of vehicle use; permitted or licensed use only; use on existing roads and trails; use on designated roads and trails; and other restrictions.

Closed Area. An area where off-road vehicle use is prohibited. Use of off-road vehicles in closed areas my be allowed for certain reasons; whoever, such use shall be made only with the approval of the authorized officer.

ONLAP. An overlap characterized by the regular and progressive pinching out, toward the margins or shores of a depositional basin, of the sedimentary units within a conformable sequence of rocks, in which the boundary of each unit is transgressed by the next overlying unit and each unit in turn terminates farther from the point of reference.

ONLAP SANDS TRAP. Onlap sands are beach sands that were deposited on an unconformity surface as sea level rose. Numerous buttress sand can occur along a single unconformity and each can form a pool.

OVERSTORY. That portion of a plant community consisting of the taller plants on the site; the forest or woodland canopy.

PALEONTOLOGICAL RESOURCE. A site containing non-human life of past geological periods, usually in the form of fossil remains.

PATENT. A grant made to an individual or group conveying fee simple title to selected public lands.

PATENTED CLAIM. A claim on which title has passed from the federal government to the mining claimant under the Mining Law of 1872.

PLANNING AREA. The geographical area for which land use and resource management plans are developed and maintained.

PUBLIC LAND. Any land and interest in land (outside of Alaska) owned by the United States and administered by the Secretary of the Interior through the Bureau of Land Management (BLM).

RAPTOR. Bird of prey with sharp talons and strongly curved beaks, e.g., hawks, owls, vultures, eagles.

RECLAMATION. Returning disturbed lands to a form and productivity that will be ecologically balanced and in conformity with a predetermined land management plan.

RECREATION AND PUBLIC PURPOSES ACT (R&PP). This Act authorizes the Secretary of the Interior to lease or convey public lands for recreational and public purposes under specified conditions to states or their political subdivisions. and to nonprofit corporations and associations.

RESOURCE AREA. A geographic portion of a BLM District that is the smallest administrative subdivision in the BLM.

RESOURCE MANAGEMENT PLAN (RMP). A land use plan that establishes land use allocations, multiple~use guidelines, and management objectives for a given planning area. The RMP planning system has been used by the BLM since about 1980.

RIPARIAN. Riparian areas are a form of wetland transition between permanently saturated wetlands and upland areas. These areas exhibit vegetation or physical characteristics reflective of permanent surface or subsurface water influence. Normally describes plants of all types that grow rooted in the water table or subirrigation zone of streams, ponds, and springs.

RIPARIAN/AQUATIC SYSTEM. Interacting system between aquatic and terrestrial situations. Identified by a stream channel and distinctive vegetation that requires or tolerates free or unbound water.

RIPARIAN ZONE. An area encompassing riparian and adjacent vegetation.

ROADLESS. As used in wilderness inventories, refers to the absence of roads which have been improved and maintained to insure relatively regular and continuous use.

ROADS. Vehicle routes which have been improved and maintained by mechanical means to ensure relatively regular and continuous use. (A way maintained strictly by the passage of vehicles does not constitute a road.)

SALINITY. Refers to the solids such as sodium chloride (table salt) and alkali metals that are dissolved in water. Often in non-saltwater areas, total dissolved solids is used as an equivalent.

SCOPING PROCESS. An early and open public participation process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action.

SEDIMENT YIELD. Amount of sediment produced in a watershed, expressed as tons, acre-feet, or cubic yards of sediment per unit of drainage area per year.

SHEET EROSION. The removal of a fairly uniform layer of soil from the land surface by runoff water.

SHORT-TIME. In this document. refers to the 10-to 12-year life of the plan. Short-term impacts would occur within that time period.

SHUT-IN. An oil or gas well that is capable of production but is temporarily not producing.

SIGNIFICANT. An action that is analyzed in the context of the proposed action and the severity of the effects either beneficial or adverse. The degree of significant is related to other actions with individually insignificant but cumulatively significant impacts. Significance exists if it is reasonable to anticipate a cumulatively significant impact on the environment. Significance exist which the effects on the quality of the human environment are likely to be highly controversial.

SPECIAL RECREATION MANAGEMENT AREA (SRMA). An area that possesses outstanding recreation resources or where recreation use causes significant user conflicts, visitor safety problems, or resource damage.

SPLIT ESTATE. Lands where the owner of the mineral rights and the surface owner are not the same party in interest. The most common split estate is Federal ownership of mineral rights and other interest ownership of the surface. Where such a condition occurs, the Federal Government can lease the oil and gas rights without surface owner consent.

STIPULATION. A provision that modifies standard lease rights and is attached to and made a part of the lease.

STREAM BANK (and CHANNEL) EROSION. The removal, transport, deposition, recutting, and bed load movement of material in streams by concentrated water flows.

STUDY AREA. Refers to all the Resource Areas and Planning Areas covered in this EIS collectively.

SUITABILITY. As used in the Wilderness Act and in the Federal Land Policy and Management Act refers to a recommendation by the Secretary of the Interior or

the Secretary of Agriculture that certain federal lands satisfy the definition of wilderness in the Wilderness Act and have been found appropriate for designation as wilderness on the basis of an analysis of the existing and potential uses of the land.

SUNDRY NOTICE. Standard form to notify or approve well operations subsequent to Application for Permit to Drill, in accordance with BLM regulations.

SUPPLEMENTAL VALUES. Resources associated with wilderness which contribute to the quality of wilderness areas.

SURFACE MANAGEMENT AGENCY. Any agency outside of the Department of the Interior with jurisdiction over the surface overlying federally owned minerals.

SUSTAINED YIELD. The achievement and maintenance in perpetuity of a high-level annual or regular periodic output of the various renewable resources of the public lands consistent with multiple-use.

SYNCLINE. A fold of which the core contains the stratigraphically younger rocks; it is generally concave upward.

TECTONICS. A branch of geology dealing with the broad architecture of the outer part of the Earth, that is the regional assembling of structural or deformational features, a study of their mutual relations, origin, and historical evolution.

TERRESTRIAL. Living or growing in or on the land.

THREATENED SPECIES. Any species or a significant population of that species likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

THRUST FAULT. A fault with a dip of 45 degrees or less over much of its extent, on which the hanging wall (overlying side) appears to have moved upward relative to the footwall (underlying side).

TIMBER. Standing trees, downed trees, or logs which are capable of being measured in board feet.

TIMING LIMITATION (SEASONAL RESTRICTION). Prohibits surface use during specified time periods to protect identified resource values. The stipulation does not apply to the operation and maintenance of production facilities unless the findings of analysis demonstrate the continued need for such mitigation and that less stringent, project-specific mitigation measures would be insufficient.

TOTAL DISSOLVED SOLIDS (TDS). Salt, or an aggregate of carbonates, bicarbonates, chlorides, sulfates, phosphates, and nitrates of calcium, magnesium, manganese, sodium, potassium, and other cations that form salts.

TRAP. Any barrier to the upward movement of oil or gas, allowing either or both to accumulate. A trap includes a reservoir rock and an overlying or updip impermeable roof rock; the contact between these is concave as viewed from below. See also: definitions of types of stratigraphic traps below.

TRESPASS. Any unauthorized use of public land.

UNCONFORMITY. A substantial break or gap in the geologic record where a rock unit is overlain by another that is not next in stratigraphic succession, such as an interruption in the Continuity of a depositional sequence of sedimentary rocks or a break between eroded igneous rocks and younger sedimentary strata.

UNDERSTORY. That portion of a plant community growing underneath the taller plants on the site.

UNIVERSAL SOIL LOSS EQUATION (USLE). A formula for predicting soil loss resulting from sheet and rill erosion caused by rainfall.

UPDIP PINCH OUT OF SANDSTONE TRAP. An updip pinch of wedge out of a sandstone in shale forms a trap. These are common in coastal plains where updip is landward. They tend to be small traps. If uplift caused dip, the trap type is combination.

UTILIZATION. The proportion of current year's forage production that was consumed or destroyed by grazing animals; usually expressed as a percentage.

VALID EXISTING RIGHTS. Legal interests that attach to a land or mineral estate that cannot be divested from the estate until that interest expires or is relinquished.

VANDALISM. Willful or malicious destruction or defacement of public property; e.g., cultural or paleontological resources.

VEGETATION MANIPULATION. Planned alteration of vegetation communities through use of prescribed fire, plowing, herbicide spraying, or other means to gain desired changes in forage availability, wildlife cover, etc.

VEGETATION TYPE. A plant community with immediately distinguishable characteristics based upon and named after the apparent dominant plant species.

VERTEBRATE. An animal having a backbone or spinal column.

VISUAL RESOURCES. The visible physical features on a landscape (topography, water, vegetation, animals, structures, and other features) that comprise the scenery of the area.

VISUAL RESOURCE MANAGEMENT (VRM). The inventory and planning actions taken to identify visual resource values and to establish objectives for managing those values, and the management actions taken to achieve the visual resource management objectives.

VISUAL RESOURCE MANAGEMENT (VRM) CLASSES. VRM classes identify the degree of acceptable visual change within a particular landscape. A classification is assigned to public lands based on the guidelines established for scenic quality, visual sensitivity, and visibility.

VRM Class I. This classification preserves the existing characteristic landscape and allows for natural ecological changes only. Includes Congressionally authorized areas (wilderness) and areas approved through the RMP where landscape modification activities should be restricted.

VRM Class II. This classification retains the existing characteristic landscape. The level of change in any of the basic landscape elements due (form, line, color, texture) to management activities should be low and not evident.

VRM Class III. This classification partially retains the existing characteristic landscape. The level of change in any of the basic landscape elements due to management activities may be moderate and evident.

VRM Class IV. This classification provides for major modifications of the characteristic landscape. The level of change in the basic landscape elements due to management activities can be high. Such activities may dominate the landscape and be the major focus of viewer attention.

VRM Class V. This classification applies to areas where the characteristic landscape has been so disturbed that rehabilitation is needed. Generally considered an interim short-term classification until rehabilitation or enhancement is completed.

VISUAL SENSITIVITY. Visual sensitivity levels are a measure of public concern for scenic quality and existing or proposed visual change.

WAIVER. Permanent exemption from a lease stipulation. The stipulation no longer applies anywhere within the leasehold.

WILDERNESS. An area formally designated by Congress as a part of the National Wilderness Preservation System.

WILDERNESS CHARACTERISTICS. Identified by Congress in the Wilderness Act of 1964; namely, size, naturalness, outstanding opportunities for solitude or a primitive and unconfined type of recreation, and supplemental values such as geological, archaeological, historical, ecological, scenic, or other features.

WILDERNESS INVENTORY. An evaluation of the public land in the form of a written description and a map showing those lands that meet the wilderness criteria as established under Section 603(a) of FLPMA and Section 2(c) of the Wilderness Act. The lands meeting the criteria will be referred to as WSAs.

WILDERNESS STUDY AREA (WSA). An area determined to have wilderness characteristics. Wilderness Study Areas will be subject to interdisciplinary analysis through BLM land use

planning system and public comment to determine wilderness suitability. Suitable areas will be recommended to the President and Congress for designation as wilderness.

WITHDRAWAL. An action which restricts the use of public land and segregates the land from the operation of some or all of the public land and mineral laws. Withdrawals are also used to transfer jurisdiction of management of public lands to other federal agencies.

Appendix A

OIL AND GAS EXPLORATION AND DEVEOPMENT

This appendix describes the process used to explore for and develop oil and natural gas resources, in general terms. As such, it is a *generally* accurate description of techniques currently used in Region 4 of the GSRA. However, there may be local differences found in Region 4; the more notable differences are described here.

Types of Drilling and Production

Oil and gas wells are drilled primarily with rotary drilling rigs. The rigs use mud or compressed air as a medium to cool the drilling tools, carry cuttings to the surface and, in the case of mud, to stabilize the drilled hole. In the early days of drilling, the "cable tool" rig was the predominant method of drilling. Cable tools were largely replaced by rotary rigs in the 1950s. Some of the oldest wells still producing in Colorado were drilled with cable tool rigs.

Whether the target production is oil or gas, the method of drilling is generally the same. The depth of the target usually has more to do with the method of drilling than the type of production. In general, deeper wells require larger rigs which in turn require larger drill pads. The size of the anticipated production also has a bearing on the expense a given production will bear. For example, a very large gas producing reservoir may better bear the cost of deeper drilling than a shallow, low producing oil reservoir. All else being equal, deeper reservoirs cost more to develop than shallow ones.

Dry Gas Production. This is the type of production predominantly found in Region 4. Dry gas is a term applied to any natural gas produced without oil. It usually has some water associated with it and may have a small amount of light liquid hydrocarbons, called "drip" or condensate. Dry gas wells typically have only a "Christmas tree," or valve/gauge assembly, showing above ground. Production facilities may include a separator and/or dehydrator, a pit or tank for the collection of separated produced water and a small tank for the storage of the liquid hydrocarbons. Gas is transported to market through a network of gathering pipelines from each well to a transmission line. The gathering system usually consists of pipe of two to four inches in diameter, which is laid on the ground or buried several feet below the surface. BLM most often requires that lines be laid near the access road or buried under it to save additional surface disturbance. Measurement of gas is usually through a differential pressure recorder on the well pad.

In some areas, hydrogen sulfide (also known as H_2S or sour gas) may be found with the hydrocarbon production. In these cases, special stainless steel pipe is used to contain the production until the hydrogen sulfide can be separated from the hydrocarbons. The hydrogen sulfide is disposed of by incineration or neutralized by sulfur extraction. There is no known H_2S within Region 4.

Oil Production. Typically, oil is produced in association with water and gas; however, in some cases oil is produced with almost no water or associated gas. The facilities to produce such oil are the same as those described below without the equipment for gas clean-up, measurement and distribution.

Oil and Gas Co-Production (currently none present in Region 4). Reservoirs that produce both oil and natural gas require the siting of facilities for the production, cleanup and storage of the products on the well pad. If the well produces naturally, that is, the gas and oil flow to the surface under natural pressures, only a series of pipes and valves at the well "head" are required to regulate the flow of product to the surface. If there is insufficient pressure, a pump is installed to lift the product to the surface. Once the oil and gas comes to the surface, it travels through pipes to separation equipment where water and gases such as carbon dioxide are removed, and the gas and oil are separated. The water and oil are piped to respective storage

facilities and the gas put into a transmission pipeline. In a few cases, separation, cleanup and/or storage facilities are located off of the well pad for common use by more than one well.

Produced oil goes into tanks, either on the well pad or a common tank near the well. The oil is measured for sale from these tanks and transported to distribution points by special truck. In the case of some highly productive fields, oil carrying pipelines may be laid to a distribution point or refinery. In that case, there is a network of pipelines to each well similar to that for the gas gathering system. The oil gathering lines are usually four to six inches in diameter, and measurement is either through a sales tank or a sales meter attached to the line.

Carbon Dioxide Production. Carbon dioxide is produced in a manner similar to dry gas. But carbon dioxide, in combination with water, may form carbonic acid which is very corrosive. Therefore, the produced gas must be "cleaned" to remove impurities as soon as possible after it reaches the surface. For that reason, stainless steel piping is used from well head to separator and the separators are placed as close as possible to the well head. Usually a single large separator is located so as to serve several wells. The use of some stainless steel pipe and common separators are the two most distinguishing surface features of carbon dioxide production.

Coal Bed Methane Production. Methane is commonly found in association with coal. It is produced either from the coal beds themselves or from nearby reservoir rock to which it has migrated from coal beds. It is produced by the same drilling and production techniques as other gases. The difference between coal bed methane and other natural gas production is that, when it is produced with associated water, the water production begins at a relatively high rate and declines to a very small amount over the first two to three years, while the gas production increases inversely. If production is interrupted because the well is "turned off" or shut down, upon re-start the water/gas ratio will be approximately the same as when the well was first produced. This phenomenon means that a great deal of water must again be produced before economic gas production is re-established. Not all coal bed methane production necessarily involves large amounts of produced water.

Phases of Exploration and Development

Oil and gas exploration and development activities progress through five phases that overlap in time: preliminary exploration, exploratory drilling, development drilling, production and abandonment. Leases are usually obtained before any exploratory drilling takes place. In Region 4, the activities currently underway are primarily associated with development drilling and production. Occasionally, some exploratory work still occurs.

Preliminary Exploration. Petroleum exploration occurs in unexplored portions of areas where petroleum is known or thought to exist in commercial quantities. Such areas are known as frontiers, or rank wildcat areas. With declining known oil and gas supplies, it has become profitable to explore for oil and gas in less promising geological provinces and in areas where the climate, terrain, depth of deposits, and other obstacles have discouraged previous efforts. Increasingly sophisticated exploration techniques, improved oil and gas drilling, and transportation technologies have also enhanced prospects for locating, extracting and marketing petroleum resources.

Geological Exploration. Where the bedrock geology of an area is well exposed, it is often possible to predict where hydrocarbons might gather. The potential traps (anticlines, faults or formations with varying porosity) can sometimes be located with the aid of published

geologic maps, aerial photos and landsat imagery. Occasionally, additional data will be gathered by aircraft. Low altitude reconnaissance flights, frequently at elevations of 100 to 500 feet, help identify rock outcrops that can be studied later on the ground. Next, one or more geologists may examine and sample the rock outcrops in the area and map the surface geology. Geological exploration can be performed with little surface damage; four-wheel drive pickups, motorcycles, or all terrain vehicles can be used to cover the area.

Geophysical Exploration. Subsurface geology is not always accurately indicated by surface outcroppings. In such cases, geophysical prospecting methods are used to define subsurface structure. Three geophysical survey techniques can be used to define subsurface characteristics through measurements of the gravitational field, the magnetic field, and seismic reflections.

Two of these, gravity and magnetic surveys, require small portable units which are easily transported via light off-road vehicles, such as four-wheel drive pickups and jeeps or aircraft. Sometimes, small holes (approximately one inch by two inches by two inches) are hand dug for instrument placement at the survey measure points. These two surveys can make measurements along defined lines, but it is more common to have a grid of discrete measurement stations.

The third type, seismic reflection surveys, is the most common of the geophysical methods and produces the most detailed subsurface information. The seismic method detects subsurface geologic structural information by producing a source wave at or near the surface that bounces off subsurface layers. The "echoes" or seismic reflections are detected by geophones and recorded as a function of time.

Exploratory Drilling

When preliminary investigations are favorable and warrant further exploration, exploratory drilling may be justified. Stratigraphic tests and wildcat tests are the two types of exploratory drill holes.

"Strat" tests involve drilling relatively shallow holes to supplement seismic data. These tests aid in revealing the nature of near-surface structural features. The holes are usually from 100 to several thousand feet deep, and are drilled primarily by rotary drill rigs. As the rock is drilled, the resulting rock chips are brought to the surface by a high-pressure airflow or circulating drilling mud. Samples of these chips are collected, bagged, and identified as to depth of origin. They are then studied by a geologist to determine such data as rock type, age, and formation.

Truck-mounted drilling equipment for strat tests is fairly mobile; therefore, roads and trails to test sites on level solid ground are temporary and involve minimal construction. In hilly or mountainous areas, more road building is necessary. A space of about one-half acre or less is leveled and cleared of vegetation for the average drill site.

The deeper wells may require several months or more to complete; shallower wells up to a few thousand feet deep may be completed in as little as a few weeks. As a general rule, the deeper the test, the larger the drilling rig and facilities required.

Prior to approval for drilling, on-site inspections are conducted with the proposed drill pad and access road staked out, to assess potential impacts and attach appropriate mitigative conditions to the permit to drill. A drill "pad" (well site) from one to four acres in size is then cleared of all vegetation, and leveled for the drill rig, mud pumps, mud (or reserve) pit, generators, pipe rack and tool house. Topsoil is usually removed and stockpiled for use in the

reclamation process. The mud pit may be lined with plastic or bentonite to prevent fluid loss or contamination of water resources. Other facilities such as storage tanks for water and fuel are located on the pad or are positioned nearby on a separate cleared area. If the well site is not large enough for the equipment required to rig-up (prepare the drilling rig for operation), a separate staging area may be constructed. Staging areas are usually no larger than 200 feet by 200 feet and may simply be a wide flat spot along the access road on which vehicles and equipment are parked.

Five thousand to 15,000 gallons of water a day may be needed for mixing drilling mud, cleaning equipment, cooling engines, etc. for each well. A surface pipeline may be laid to a stream or a water well, or the water may be trucked to the site from ponds or streams in the area.

The rigs are very large and may be moved in pieces. In some instances, rigs can be moved short distances on level terrain with little or no dismantling of equipment which will shorten the tearing-down and rigging-up time. Moving a dismantled rig involves use of heavy trucking equipment for transportation, and crews to erect the rig. Gross weight of vehicles may run in excess of 80,000 lbs.

In order to move a drill rig and well service equipment from one site to another, and to allow access to each site, temporary roads may be built. These roads are generally 16 to 18 feet wide (driving surface) and may be as short as a few feet or as long as ten miles or more. Bulldozers, graders, and other types of heavy equipment are used to construct and maintain temporary wildcat roads.

The start of a well is called "spudding in." A short piece of tubing called conductor pipe is forced into the ground (sometimes with a pile driver) and cemented in place. This keeps surface sand and dirt from sloughing into the well hole. Next, the regular drill bit and drill string (the column of drill pipe) take over. These pass vertically through a heavy steel turntable (the rotary table) on the derrick floor and the conductor pipe. The rotary table is geared to one or more engines and rotates the drill string and bit. As the bit bores deeper into the earth, the drill string is lengthened by adding more pipe to the upper end. (See Figure A-I).

Once the hole reaches a depth of several hundred feet, another string of pipe (the surface casing) is set inside the conductor pipe and cemented in place. The actual length of this "surface casing" is dependent on factors such as depth of freshwater zones, anticipated pressures, and the length of the next smaller casing to be set. The annular space between the borehole and the exterior of the surface casing is required to be filled with cement. Cement is pumped down the casing and around the bottom until cement is returned to the surface outside of the casing. This ensures cement completely fills the annular space and precludes interzonal migration of formation fluids (i.e., groundwater).

Surface casing acts as a safety device to protect freshwater zones (aquifers) from contamination. To prevent the well from "blowing out" in the event the drill bit hits a high pressure zone, blowout preventers are installed above the surface casing just below the derrick floor. The blowout preventers allow containment and control of the pressure.

After setting the surface casing, drilling resumes using a smaller diameter bit. Depending on well conditions, additional strings of casings (intermediate casing) may be run (installed) before the well reaches the objective depth (total depth or "T.D.").

During drilling, a mixture of water, clay, and chemical additives known as "mud" is continuously pumped down the drill pipe. It exits through holes in the bit and returns to the surface outside the drill pipe. As the mud circulates, it cleans and cools the bit and carries the rock chips (cuttings) to the surface. It also helps to seal off the sides of the hole (thus

preventing cave-ins), and to control the pressure of any water, gas or oil encountered by the drill bit.

The mud is the first line of defense against a possible blow-out since it is used to control pressure. It is for this reason that a pit full of "reserve" mud (the reserve pit) is maintained on location. The reserve mud is used in emergencies to restore the proper drilling environment when radical or unexpected changes in down-hole pressure are encountered.

The cuttings are separated from the mud and sampled so that geologists can note and analyze (log) the various strata through which the bit is passing. The rest of the cuttings pass into the reserve pit as waste. Some holes are drilled at least partially with compressed air which serves the same purpose as the drilling mud of cooling and cleaning the bit and evacuating the cuttings from the hole.

During or at completion of drilling activity, the well is logged. Logging means measuring with geophysical instruments the physical characteristics of the rock formations and associated fluids through which the borehole passed. These instruments are lowered to the bottom of the well, and slowly raised to the surface while recording data. Other measuring procedures include the drill stem test in which pressures are recorded and fluid samples taken from zones of interest. After studying the data from those logs and tests, the geologist and/or petroleum engineer decide if the well will produce gas.

If the well did not encounter oil and/or gas, it is plugged with cement and abandoned. The well pad and access road are recontoured and revegetated.

If the well will produce, casing is run to the producing zone and cemented in place. A proper cementing of the production casing string is required to provide coverage and prevent interzonal communication between oil and gas horizons and usable water zones. Cement is placed in a similar fashion to the surface pipe. However, a quantity of cement sufficient to cover and isolate only those zones having hydrocarbons, usable water, or other mineral values is used. (See Figure A.)

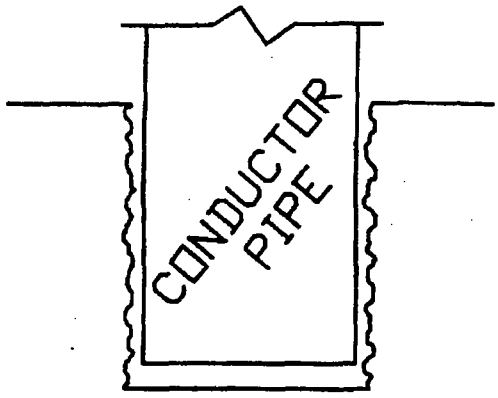
If the determination is made that water monitoring wells are necessary in a given area, a separate borehole specifically designed as a monitoring well should be completed. Logical placement of a monitoring well would be in a protected location at the edge just off of the well pad (generally 100-200 feet from producing well bore). It should be noted also that monitoring wells and other relatively shallow boreholes have often had adverse impacts on the most critical groundwater source due to interzonal flows and introduction of bacteria and other contaminants into the system. The drill rig is usually replaced by a smaller rig that is used for the final phase of completing the well.

Development Drilling

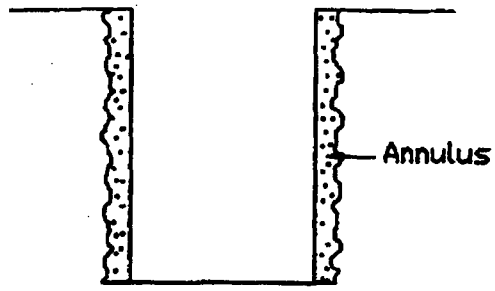
If a wildcat well becomes a discovery well (a well that yields commercial quantities of oil or gas), development wells will be drilled to confirm the discovery, to establish the extent of the field, and to efficiently drain the reservoir. The procedures for drilling development wells are about the same as for wildcats, except there is usually less subsurface sampling, testing, and evaluation.

Several downhole acid or fracture treatments may be necessary to enhance the formation permeability to make the well flow. "Acidizing" a well refers to the process of placing acid in the well bore across the productive interval which causes the solution of some of the mineral materials (eg., calicide, dolorite, etc.) that reside

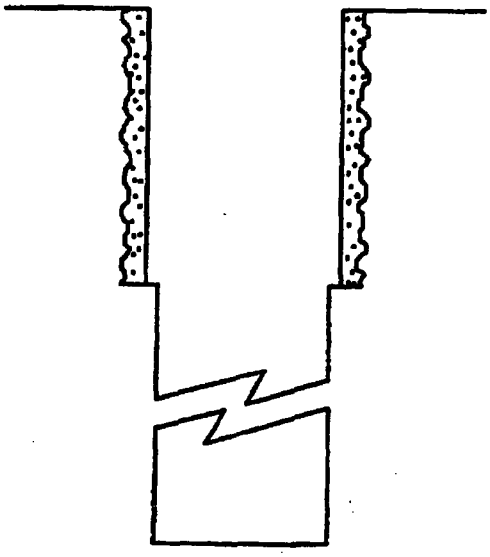
Figure A-1. Protective Casing for Producing Wells



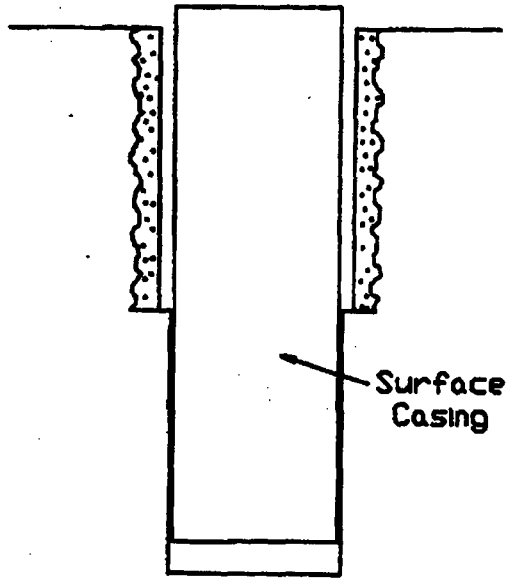
1. Well is initially started with an oversized bit and drilled up to 50 feet deep. A large-diameter pipe known as a conductor pipe is lowered into the hole to keep surface soil from stuffing into the hole while the surface casing hole is being drilled out.



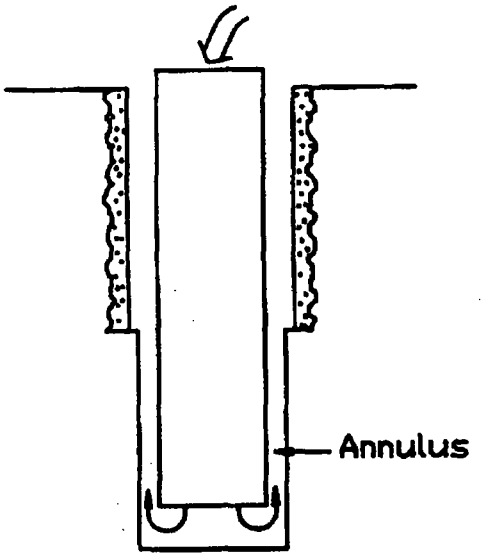
2. Cement is placed in the annulus (the space between the well hole and the pipe, or between a smaller and larger pipe).



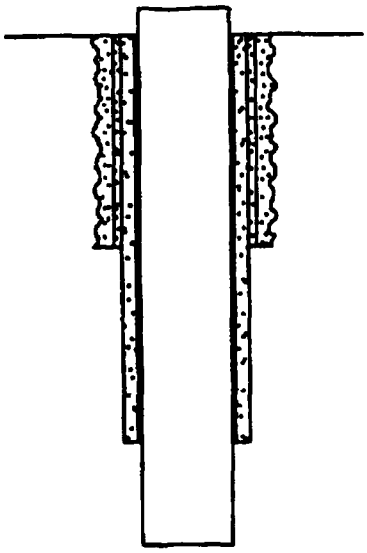
3. Surface casing hole is drilled out from inside the conductor to a pre-determined depth, typically about 10% of the total depth.



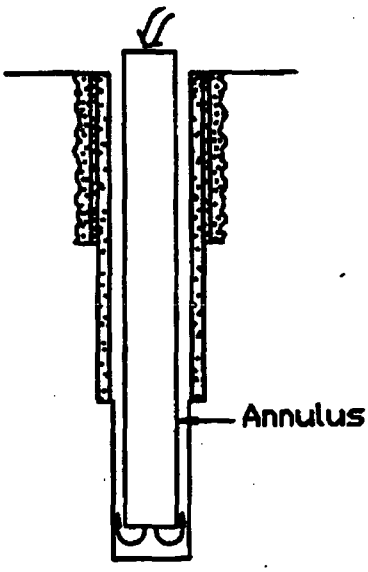
4. Surface casing is lowered into the hole.



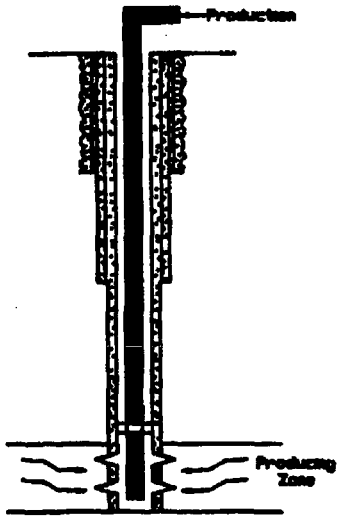
5. Cement is pumped down the surface casing and forced up the outside through the annulus. The cement is used to hold the surface casing in place. It protects shallow fresh water and other mineral zones.



6. The well is deepened using a bit smaller than the surface casing. The well is now drilled to its final depth. In deep wells, intermediate casing is set before drilling to the final depth.



7. The intermediate, or production, casing is lowered into the hole. Cement is pumped down the casing and up the outside through the annulus to seal the casing in place. This cement will also isolate and protect all hydrocarbon-bearing and fresh water zones.



8. Once the production casing is in place, perforations are made through the casing and cement into the producing formation. The flow of oil and gas into the well is increased. Production tubing is hung down the well to the producing zone. Oil and gas flow into the well and flow or are pumped to the surface through the production tubing.

around the pore space. Upon solution and removal of these minerals, porosity and permeability are enhanced.

When a well is hydro-fractured, it simply means fluid, usually gelled water, is pumped down the well through perforations in the casing and into the formation. Pumping pressures are increased to the point where the formation fractures or breaks, and the sand is added to the injection fluid to "prop-open" the crack once the pressure is released. The pressure required to fracture a given formation is generally quite predictable based on rock type and depth. For some formations, especially coals, abnormally high pressures are required to fracture them. Pressures, volumes, and rates are all measured and monitored during the fracture process. These parameters provide information as to how the formation is behaving and if the fracture is propagating within the desired interval (i.e., staying in zone). This is especially true in coals, as sustained "high" injection pressure indicates the fracture is moving through the coal. If pressures fall off, it indicates the fracture has extended beyond the coats and the operation can be halted. In addition to using the foregoing parameters to monitor fracture behavior, there are other methods for monitoring fracture geometry and extent available, eg., tracer and tiltimeter surveys. Control is maintained throughout the fracture operation.

A free-flowing well is simply closed off with an assembly of valves, pipes, and fittings (called a christmas tree) to control the flow of oil and gas to other production facilities. A gas well may be "flared" for a short period (up to three days) in order to remove the fracturing fluids from the well and to measure the amount of gas the well can produce. The well is then shut in or connected to a gas pipeline.

If an oil well is not free-flowing, it will be necessary to use artificial lift (pump) methods. These are explained along with well production equipment and procedures, in the following section on production. After a pump is installed, the well may be tested for days or months to see if it is economically justifiable to produce the well and to drill additional development wells. During this phase, more detailed seismic work may be run to assist in precisely locating the petroleum reservoir and to improve previous seismic work.

Coal-bed methane wells generally require artificial lift to remove formation water which reduces the confining pressure, causing gas to be released (desorbed) from the coals. Once the gas is freed from the coal surfaces, it moves toward the "pressure sink" which is the well bore. As gas is liberated, it flows preferentially to the water (i.e., relative permeability is higher for gas), thereby reducing water production rates and increasing gas production rates. In many cases, the artificial lift equipment will no longer be necessary once sufficient gas flow is established.

As with wildcat wells, field development well locations will be surveyed. As development occurs, a well spacing pattern is established.

Spacing

After an exploratory well has been completed, a company will request that the COGCC approve a well spacing pattern for the area. The initial spacing is typically based on the type of well(oil or gas) and the depth to which it is drilled. The spacing request also reflects the calculated area that one well can effectively drain, based on the initial reservoir characteristics. An approved spacing order pools the interests of the affected lessees within the spaced area. This protects the existing wells from being drained by offset wells and allows the lessees within the spaced area to share in the production. Without spacing, all lessees would need to drill their own wells to protect their leases from drainage. This would lead to the drilling of unnecessary wells.

As development of a field takes place, additional knowledge of the characteristics of the field is

gained. From this information, it may be determined that additional wells are needed to effectively drain the spacing unit. When this determination is made, a company may request a modification of the approved spacing order to allow additional wells within the spaced area. Since the size of the original spacing unit is not changed, approval of additional wells is referred to as increased density.

In Colorado, most fields are developed on a 40, 80, 160, 320, or 640 acre pattern. In some areas in Region 4, the existing spacing orders have been modified to allow up to 16 wells per section in some areas. Forty acres (16 wells per section) is the spacing pattern authorized for all unspaced areas.

During the development stage, the road system of the area is greatly expanded. Once it is known which wells produce and their potential productive life, a road system can be designed and built. Because it often takes several years to develop a field and determine field boundaries, the road system is usually built in segments. Since the roads in an expanding and developing field are built in segments, many temporary roads (built initially for wildcats or development) end up as long-term (in excess of 15 years) main access or haul roads. The planning of temporary roads for wildcats and development wells is done with road conversion to long term in mind.

Development wells have a higher success rate than wildcat wells, so access roads for development wells tend to be better planned, designed, and constructed. Access roads are normally limited to one main route to serve the lease areas, with a maintained side road to each well. Upgrading of temporary roads may include ditching, draining. installing culverts, graveling. crowning, or capping the roadbed. The amount of surface area needed for roads would be similar to that for temporary roads mentioned earlier, and would also be dependent on topography and loads to be transported over it. Generally, main access roads are 20 to 24 feet wide and side roads are 14 to 18 feet wide. These dimensions are for the driving surface of the road and not the maximum surface disturbance associated with ditches, back cuts, or fills. The difference in disturbance is simply a matter of topography. Surface disturbance in excess of 130 feet is not unusual in steep terrain.

In addition to roads, other surface uses for development drilling may include: flowlines; storage tank batteries; facilities to separate oil, gas and water (separators and treaters); and injection wells for salt water disposal. Some of the facilities may be installed at each producing well site, and others at places situated to serve several wells. These facilities are discussed more in the following production section.

Surface use in an oil and gas field may be affected by unitization of the leaseholds. In many areas with federal lands, an exploratory unit is formed before a wildcat is drilled. The boundary of the unit is based on geologic data. The developers unitize the field by entering into an agreement to develop and operate it as a unit without regard to separate ownerships. Costs and benefits are allocated according to agreed terms.

Unitization reduces the surface-use requirements because all wells are operated as though on a single lease. Duplication of field processing facilities is minimized because development operations are planned and conducted by a single unit operator, often resulting in fewer wells.

The rate at which development wells are drilled depends on whether the field is operated on an individual lease basis or unitized, the probability of profitable production, the availability of drilling equipment, protective drilling requirements (drilling requirements to protect federal land from subsurface petroleum drainage by off-setting nonfederal wells), and the degree to which limits of the field are known. The most important development rate factor may be the quantity of production. If the discovery well has a high rate of production and substantial

reserves, development drilling usually proceeds at a fairly rapid pace. If there is some question whether reserves are sufficient to warrant additional wells, development drilling may occur at a much slower pace. An evaluation period to observe production performance may follow between the drilling of successive wells.

Development on an individual lease basis usually proceeds more rapidly than under unitization, since each lessee must drill his own well to obtain production from the field. On a unitized basis, however, all owners within the participating area share in a well's production regardless of whose lease the well is on. Spacing requirements are not applicable to unit wells. The unit is developed on whatever the operator considers to be the optimal spacing pattern to maximize recovery.

As mentioned earlier, drilling in an undeveloped part of a lease to prevent drainage of petroleum to an offset well on an adjoining lease (protective drilling) is frequently required in fields of intermingled federal and privately owned land. The terms of federal leases require such drilling if the offset well is on nonfederal lands, or on federal lands leased at a lower royalty rate.

Many fields go through several development phases. A field may be considered fully developed and produce for several years, then a well may be drilled to a deeper pay zone. Discovery of a new pay zone in an existing field is a "pool" discovery, as distinguished from a new field discovery. A pool discovery may lead to the drilling of additional wells — often from the same drilling pad as existing wells — with the boreholes separated only by feet or inches. Existing wells may also be drilled deeper.

Usually four-to-six inch diameter pipelines transport the petroleum between the well, the treating and separating facilities, and central collection points. These lines can be on the surface, buried, or elevated. Most pipelines in Region 4 are buried.

Trucking and pipelining are the two methods used separately or in conjunction to transport oil out of a lease or unitized area. Trucking is used to transport crude oil or condensate from fields where installation of pipelines is not economical and the natural gas in the field is not economically marketable. It is not practical to truck natural gas.

Pipelines are the most common way to transport oil and gas. If a field has substantial amounts of natural gas, separate pipelines will be necessary for oil and gas. Pipelines move the oil from gathering stations to refineries. As existing fields increase production or new fields begin production, new pipelines may be needed. These new lines usually vary in size from four to 16 inches in diameter, and range in length from a few miles to tie into an existing pipeline, to hundreds of miles to supply a refinery. Construction of a pipeline requires excavating and hauling equipment, a temporary and/or permanent road, possibly pumping stations, clearing the right-of-way of vegetation, and possibly blasting.

Natural gas pipelines transport gas from the wells (gathering or flow lines) to a trunk line then to the main transmission line from the area. Flow lines are usually two-to-four inches in diameter and may or may not be buried. Trunk lines are generally six-to-eight inches in diameter and are buried, as are transmission lines which vary in diameter from ten-to-36 inches. The area required to construct a pipeline varies from about 15 inches wide (for a two to four inch surface line) to greater than 75 feet for the larger diameter transmission lines (24 to 36 inches). Surface disturbance is primarily dependent on size of the line and topography of the area on which the line is being constructed.

Compressor stations may be necessary to increase production pressure to the same level as pipeline pressure. The stations vary in size from approximately one acre to as much as twenty acres for a very large compressor system.

Construction techniques for natural gas lines are similar to those used for oil pipelines.

Production

Production in an oil field begins just after the discovery well is completed and is usually concurrent with development operations. Temporary facilities may be used at first, but as development proceeds and reservoir limits are determined, permanent facilities are installed. The extent of such facilities is dictated by the number of producing wells, expected production, volume of gas and water produced with the oil, the number of leases, and whether the field is to be developed on a unitized basis.

The primary means of removing oil from a well is by pumping jacks (familiar horsehead devices). The pumps are powered by electric motors (power lines required) or if there is sufficient casinghead gas (natural gas produced with the pumped oil), or another gas source is available, it may be used to fuel internal combustion engines.

Some wells drilled in the area produce water that must be disposed of during the operation of the well. Although most produced waters are brackish to highly saline, some are fresh enough for beneficial use. If water is to be discharged, it must meet certain water quality standards. Because water may not come from the treating and separating facilities completely free of oil, oil skimmer pits may be established between separating facilities and surface discharge.

Another method of disposing of wastewater is through subsurface injection. In Colorado, injection disposal wells are authorized by the COGCC under primacy of the U.S. Environmental Protection Agency. BLM engineers review the proposal for impacts to other minerals and groundwater, but have no approval authority over the well or target zone. When water is disposed of underground, it is always introduced into a formation containing water of equal or poorer quality. It may be injected into the producing zone from which it came or into other producing zones. In some cases, it could reduce the field's productivity and may be prohibited by state regulation or mutual agreement of operators. In some fields, dry holes or depleted producing wells are used for salt water disposal, but occasionally new wells are drilled for disposal purposes. Cement is squeezed between the casing and sides of the well to prevent the salt water from migrating up or down from the injection zone into other formations.

Underground oil is under pressure in practically all reservoirs. This pressure is usually transmitted to the oil through gas or water in the reservoir with the oil. When oil is pumped out of the well, pressure is reduced in the reservoir around the drill hole. This allows the gas or water in the reservoir to push more oil into the space next to the well. A reservoir that has mostly gas pushing the oil is called "gas drive," and one that has mostly water pushing the oil is called "water drive." Oil that is recovered under these natural pressures is considered primary production. Primary production accounts for about 25 percent of the oil in a reservoir.

Methods of increasing recovery from reservoirs generally involve pumping additional water or gas into the reservoir to maintain or increase the reservoir pressure. This process is called secondary recovery. Recently, the trend has been to institute secondary recovery processes very early in the development of a field. Surface disturbance from a water flooding recovery system is similar to drilling and development of an oil and gas well itself. i.e., a drill pad and access road are constructed and water pipelines may be built. Surface use is increased substantially since as many as four injection wells may be used for each oil well in the field (there are many different patterns as well as many other methods of secondary recovery).
Tertiary recovery methods increase recovery rates by lowering the viscosity of the oil either by heating it or by injecting chemicals into the

reservoir so that the oil flows more easily. Heating of reservoir oil can be accomplished by injecting steam into the reservoir. Tertiary recovery methods are not yet widely used in this area. By the year 2000, total recovery from any given oil reservoir, including secondary and tertiary recovery, is expected to average 40 percent nationally.

Crude oil is usually transferred from the wells to tank storage facilities (a tank battery) before it is transported from the lease. If it contains gas and water, they are separated before the oil is stored in the tank battery. The treating and separating facilities are usually located at a storage tank battery on or near the well site.

After the oil, gas and water are separated, the oil is piped to storage tanks located on or near the lease. There are normally at least two tanks; so that one tank can be filling as the contents of the other are measured, sold, and transported. The number and size of tanks vary with the rate of production on the lease, and with the extent of automation in gauging the volume and sampling the quality of the tank's contents.

Directional Drilling. In some situations, directional drilling can be used to help reduce the amount of surface disturbance necessary to drill wells. Directional drilling involves locating the drilling pad in one location, angling the hole in a certain direction, and producing the oil and gas from a different location. Using this technique, multiple wells may be drilled from one surface location, or the surface location may be moved to an area that causes less surface disturbance or environmental impacts.

There are, however, some concerns associated with directional drilling. The cost of drilling of directional well is higher than a vertical well since specialized equipment is needed. Also, since the hole is drilled at an angle instead of vertically, there is an increased risk of the drilling equipment becoming stuck in the hole. This could lead to significantly increased drilling time and cost, or even the abandonment of a hole. There are also limits to the distance that a directional hole can be drilled.

Abandonment

The life span of fields varies because of the unique characteristics of any given field. Reserves, reservoir characteristics, the nature of the petroleum, subsurface geology, and political, economic, and environmental constraints all affect a field's life span from discovery to abandonment. The life of a typical field is 15 to 50 years. Abandonment of individual wells may start early in a field's life and reach a maximum when the field is depleted.

Well plugging and abandonment requirements vary with the rock formations, subsurface water, well site, and the well. In all cases, all formations bearing useable water, oil, gas, or geothermal resources, and/or prospectively valuable deposits of minerals will be protected. Generally, in a dry (never produced) well, the hole below the casing is filled with heavy drilling mud, a cement plug is installed at bottom of the casing, the casing is filled with heavy mud, and a cement cap is installed on top. A pipe monument giving the location, lease number, operator, and name of the well is required unless waived by the Authorized Officer. If waived, the casing may be cut off and capped below ground level. Protection of aquifers and known oil and gas producing formations may require placement of additional cement plugs.

In some cases, wells that formerly produced are plugged as soon as they are depleted. In other cases, depleted wells are not plugged immediately but are allowed to stand idle for possible later use in a secondary recovery program. Truck-mounted equipment is used to plug former producing wells. In addition to the measures required for a dry hole, plugging of a depleted producing well requires a cement plug in the perforated section in the producing zone.

If the casing is salvaged, a cement plug is put across the casing stub. The cement pumpjack foundations are removed or buried below ground level. Surface flow and injection lines are removed, but buried pipelines are usually left in place and plugged at intervals as a safety measure.

After plugging, the drilling rig is removed and the surface, including the reserve mud pit, is restored to the requirements of the surface management agency. This may involve the use of dozers and graders to recontour those disturbed areas associated with the drill pad plus the access road to the particular pad. The reserve pit (the pan of the mud pit in which a reserve supply of drilling fluid and/or water is stored) must be evaporated or pumped dry, and filled with soil material stockpiled where the site was prepared. There will be little leakage if the pit was lined with plastic or bentonite. The area will be reshaped to a useful layout that will allow revegetation to take place, restore the landform as near as possible to its original contour, and minimize erosion. After grading the subsoil and spreading the stockpiled topsoil, the site is seeded with a seed mixture that will establish a good growth. A fence may be erected to protect the site until revegetation is complete, particularly in livestock concentration areas.

Appendix B

OIL AND GAS LEASING AND PERMITTING

BLM Authority and Responsibilities for Oil and Gas Operations

The BLM has responsibility for environmental protection, public health, and safety related to oil and gas operations on public lands. Three pieces of legislation give primary direction to the BLM for these operations: the Mineral Leasing Act of 1920, as amended; the National Environmental Policy Act of 1969; and the Federal Land Policy Management Act of 1976. Other legislation affects various aspects of development, notably, laws to protect cultural resources and endangered species.

In addition, on November 18, 1997, the President signed the National Defense Authorization Act for FY '98 (P.L. 105-85) which included provisions directing the transfer of jurisdiction of Naval Oil Shale Reserves (NOSRs) 1 and 3, from the Department of Energy (DOE) to the Department of the Interior (DOI) and directs that these areas be leased for natural gas development.

Mineral Leasing Act. The Mineral Leasing Act directs the BLM to make public land available for development of oil and gas resources and directs that a portion of the royalties collected from oil and gas leasing be returned to the State in which the leasing occurred.

National Environmental Policy Act. The National Environmental Policy Act of 1969 (NEPA) directs all federal agencies to involve the public in decision-making, to consider alternatives and to disclose the impacts of major federal actions. The BLM prepares an Environmental Impact Statement (EIS) or an Environmental Assessment (EA) to fulfill the mandate of NEPA. This SEIS is being prepared, in part, as a requirement of NEPA.

Federal Land Policy and Management Act. The Federal Land Policy and Management Act of 1976 (FLPMA) instructs the BLM to prepare land use plans and to involve the public in preparation of those management plans. To fulfill these requirements, BLM prepares Resource Management Plans (RMP) which are updated as needed. The Glenwood Springs Resource Area prepared an RMP in 1984 and has revised it on several occasions, including a 1991 revision for oil and gas leasing which was based on the Colorado Oil and Gas Leasing and Development Final EIS. The Glenwood Springs RMP, as revised, essentially directs that all BLM lands in the resource area, except for Wilderness Study Areas, be open to oil and gas leasing and development, subject to lease stipulations.

Public Law 105-85. Public Law 105-85 is the Department of Defense Authorization Act for FY 1998. (See Appendix C.) It contains provisions (section 3404) which affect Naval Oil Shale Reserves 1 and 3. The law transfers the jurisdiction of these lands (approximately 56,000 acres) from the Department of Energy to the Department of Interior. The law directs DOI to lease, within one year of enactment of the legislation, those NOSR lands which contain natural gas wells, pipelines, and associated facilities already developed by DOE. These lands are referred to as the "NOSR Production Area" throughout this SEIS.

The law also provides that all royalties generated by leasing the NOSR be deposited directly into the U.S. Treasury with no provision for distributing any portion of those receipts to the State of Colorado under the Mineral Leasing Act until certain costs accrued by DOE would be recouped.

According to the law, BLM will also enter into leases for oil and gas for the remaining NOSR lands as soon as practicable. However, this SEIS addresses oil and gas leasing in the NOSR Production Area only.

The Oil and Gas Leasing Process

Leases provide the right to develop and produce oil and gas resources from a designated parcel of public land for a specific period of time. They are offered with stipulations or notices. Stipulations modify standard lease rights and are attached to the lease. Notices are issued to implement regulations and operating orders and serve only to alert the operator to a specific item of importance pertaining to the lease.

Oil and gas leases are offered for sale at a public auction. Those people interested in purchasing oil and gas leases may nominate a lease parcel, or BLM may offer parcels of its choosing. In either case, the proposed parcel must conform to the land use plan decisions and be offered for sale at a public auction. Those parcels which do not sell at the auction are available for non-competitive sale for a two-year period thereafter.

Written public notice of the lease sale (which includes the list of parcels offered, their locations, and the stipulations to be attached) is given 45 days prior to the sale.

The purchaser of a lease at the auction must bid at least two dollars per acre. Bonus bids must be paid at the sale; rental is due at the beginning of each new year as long as the lease is held and is not producing. Leases purchased, either at auction or non-competitively, may be held in non-producing status for ten years.

If the lessee establishes production, a royalty of twelve and one-half percent must be paid to the government. Half of that money is returned to the state of origin. As mentioned previously, PL 105-85 affected the distributions of receipts from oil and gas leasing on the NOSR.

Oil and Gas Leases

Oil and gas leases issued by the BLM at the direction of Congress (1920 Mineral Leasing Act, as amended) grant a property right, limited only by the stipulations attached to the lease, and represent a contract between the Government and the lease holder. The lease rights granted consist of the right to occupy as much of the lease surface as is reasonable for the extraction of the resource and the right to remove the resource (oil and/or gas). Thus, the lease gives the operator the right to conduct any activities necessary to develop and produce natural gas from the lease area, including drilling wells, building roads and constructing pipelines and related facilities. Section 6 of the standard lease form restricts the lease rights granted by requiring protection of other resources during development of the oil and gas. (See Appendix D.)

If greater resource protection is required than Section 6 can provide, stipulations are appended to the lease. Stipulations are applied by legal description to oil and gas leases on the basis of standard quarter-quarter sections (40 acres) or lots. These stipulations may be applied to all federal mineral estate regardless of surface ownership. The U.S. Forest Service develops stipulations for attachment to leases of the federal mineral estate under National Forest System lands.

Waivers, exceptions, or modifications of the stipulations can only be granted by the Authorized Officer (AO). If the proposed waiver, exception, or modification is inconsistent with the RMP, the land use plan must be amended to accommodate the change.

BLM cannot restrict operations under a lease, even if subsequent planning documents directs the application of certain operating conditions, if such conditions are not consistent with the lease rights granted. This principle is especially important in the Glenwood Springs Resource Area, where

about 95% of Region 4, the focus of this SEIS, was leased prior to the 1991 Oil and Gas Leasing and Development Final EIS. Therefore, most of the existing leases include only the standard lease terms and conditions and contain none of the lease stipulations described in that document. Such a situation affects BLM's ability to control operations on these leases.

However, the leases are still subject to current laws and regulations. The most important of these include: NEPA, FLPMA, and the 1987 amendment to the Federal Oil and Gas Leasing Reform Act (FOOGLRA). FOOGLRA requires the Secretary of the Interior to regulate all surface disturbing activities and to take actions required in the interest of conservation of surface resources. For example, mitigation to protect public lands from unnecessary and undue degradation is consistent with lease rights. BLM records to justify restrictions to prevent unnecessary and undue degradation must take into account the contractual rights of the lessee and the resource commitments commensurate with management of an oil and gas lease. The record must also document the consideration of alternative mitigation and the extent of necessary and due degradation when concluding that the proposed operation would constitute unnecessary and undue degradation of the public lands and resources.

In the absence of a lease stipulation, a Condition of Approval (COA) to address a well-documented need may be attached to an APD and would be considered consistent with the lease rights when the mitigation accomplishes all of the following: (1) provides reasonable resource protection; (2) is based on a site-specific assessment of impacts; (3) has relatively minor impacts on the operator; (4) is technically feasible; (5) does not render the operation uneconomical; and (6) is consistent with 200 meter/60-day rule.

The 200 meter/60 day rule, part of the standard lease terms, provides that the AO can move any well up to 200 meters or impose a seasonal closure up to 60 days in length and still be consistent with lease rights.
In the absence of a lease stipulation, a COA attached to an APD would not be considered consistent with lease rights if the COA is intended to prevent impacts that can be considered necessary and due degradation resulting from the operation of a valid lease. Additionally, any exceptions to the 200 meter/60-day rule can be imposed only if necessary to prevent unnecessary and undue degradation.

Applications for Permits to Drill

A well must be drilled in order to produce oil and/or gas from the lease. Before drilling a well, the lessee, or an operator for the lessee, must file an Application for Permit to Drill (APD) with the Resource Area Office in which the action will take place. The application must include a plan for the drilling of the well and a surface use plan. The drilling plan contains information as to the depth of the well, how it will be constructed, how groundwater and other mineral resources will be protected, and how blowouts and other emergencies will be prevented or dealt with. The surface use plan discloses the exact location and amount of surface disturbance and states how that disturbance will be reduced. If the APD does not have the appropriate information and mitigation incorporated, the application may be modified or rejected.

In some cases, the U.S. Government owns and leases the federal mineral estate under lands in which the surface is privately owned. Such a situation is often referred to as a split-estate. The process for approving APDs on split-estate lands is the same as when both the surface and sub-surface are owned by the U.S. Government. In instances of split-estate lands, BLM requires that the operator obtain a surface use agreement with the surface owner prior to approving the APD. In the event of conflicts between the

surface owner and the lease holder, BLM will attempt to facilitate a resolution, but regulations ultimately direct how such conflicts be resolved. APD information is posted in the local authorizing office for a 30-day public notice period. Depending on the amount of public interest in an area, a news release may be issued or letters may be sent to interested parties announcing the receipt of the APD and subsequent public comment period. Each lease where an APD is proposed is checked to see if a bond has been posted to cover abandonment of the well should the lessee or operator default on his obligations under the lease.

Environmental Assessments

After the APD is submitted, BLM will conduct an on-site examination of the proposed well location(s), often inviting members of the public, and begin the preparation of a site-specific Environmental Assessment (EA). The EA discloses the environmental affects of the proposal and includes mitigation, to the extent possible, of impacts on wildlife, cultural resources, vegetation, soil, surface water, and other land uses and values. In the EA, each natural resources issue, management conflict or public concern is evaluated in light of the Resource Management Plan (RMP). Often the surface use plan is modified by the operator based on the on-site exam or the EA. BLM will usually attach Conditions of Approval (COA) to the APD. A COA is a provision or requirement of the operator in order for the APD to be authorized.

At a minimum, each APD is reviewed by a BLM geologist, petroleum engineer, surface reclamation specialist and the Area Manager. The geologist evaluates the need for protection of groundwater and other mineral resources and the structural competency of casing point formations. The petroleum engineer evaluates the drilling plan, the well construction and the safety of the operation. The surface reclamation specialist evaluates the surface plan, checks the proposal against the RMP and other guidance, conducts the on-site inspection, analyzes impacts, proposes mitigation, and writes or coordinates the preparation of the EA. The surface reclamation specialist also calls upon other expertise as needed in the analysis of impacts, recommendation of mitigation and reclamation requirements. For example, the BLM archaeologist would recommend any needed mitigation for impacts on cultural resources.

In cases where a proposed well is obviously part of a larger development and such development has not already been scrutinized by a NEPA document other than the RMP, an EA will be prepared on the larger development. This EA looks at conformance of the Plan of Development (POD), with the general development analyzed in the RMP.

Voluntary Protection Measures

Whatever the stipulations attached to a lease, BLM and the lease holder may agree on many non-stipulated measures to reduce resource impacts on a voluntary basis. Such voluntary agreements often permit the application of some or all of the stipulations contained in the 1991 Final EIS as COAs on APDs. Similarly, any of the operating practices described in this SEIS that would be inconsistent with lease rights already granted could be applied on a voluntary basis.

For those lands not yet leased, future leases would include appropriate stipulations to implement any of the appropriate operating practices developed in this SEIS.

Field Inspections

Field operations are inspected by the BLM to assure production accountability and compliance with the safety and environmental requirements.

Inspections are made at the pre-drill, construction, drilling, and production phases. Inspections are also made at the plugging of the well, during reclamation, and periodically thereafter as necessary to insure that reclamation is effective.

The primary responsibility of BLM petroleum engineering technicians is to account for accurate and complete measurement of production. This permits accurate accounting of royalty payments. They perform inspections to check the installation and calibration of measuring devices such as tanks for oil and flow meters for gas. Petroleum engineering technicians also inspect for environmental, public health and safety concerns.

Other BLM employees are responsible for inspecting operator compliance with stipulations and COAs. Such BLM employees may be trained as surface reclamation specialists or may have skills as geologists, archaeologists, wildlife biologists, or range conservationists.

Well Abandonment

As a well plays out and comes to the end of its usefulness, it is abandoned and the disturbed area reclaimed. The operator must submit an abandonment notice for approval. The notice is evaluated by a petroleum engineer to determine that the well will be plugged so as to protect freshwater zones, other mineral resources, and the surface from contamination by any oil or gas that might leak up from the depleted reservoir or by other fluids and gases uphole or on the surface that could migrate through the old well bore (and casing if left in place) to harm other resources.

The surface reclamation specialist checks the final reclamation proposal to insure it is in accordance with the original APD requirements and incorporates the latest methods of reclamation. Reclamation is required to restore the well site, road, and other disturbances to a condition as close to the original as possible or better. The surface reclamation specialist also inspects the location as needed to monitor the progress of reclamation. If the reclamation does not meet the requirement set out in the APD, the operator will re-do those portions necessary to complete the goals for the reclaimed area. The well will continue to be monitored until the surface reclamation specialist is satisfied that the reclamation has succeeded and the location is stable.

Appendix C

PUBLIC LAW 105-85

The National Defense Authorization Act
for FY 1998

The National Defense Authorization Act for FY 1998

Legislation transferring jurisdiction of NOSRs 1 and 3 to the DOI is contained in the provisions of Title XXXIV - Naval Petroleum Reserves - Section 3404 of the National Defense Authorization Act for FY 1998 (DAA). The DAA was signed into law On November 18, 1997, by the President and designated Public Law 105-85.

Sec. 3404, Transfer of Jurisdiction, Naval Oil Shale Reserves Numbered 1 and 3, (a), Transfer Required, Chapter 641 of Title 10, United States Title Code, is amended by adding at the end of the following new section, Section 7439, Certain oil shale reserves: transfer of jurisdiction and petroleum exploration, development and production.

Sec. 3404, Transfer of Jurisdiction, Naval Oil Shale Reserves Numbered 1 and 3, (a), Transfer Required, (1) Upon the enactment of this section, the Secretary of Energy shall transfer to the Secretary of the Interior administrative jurisdiction over all public domain lands included within Oil Shale Reserve Numbered 1 and those public domain lands included within the undeveloped tracts of Oil Shale Reserve Numbered 3.

Sec. 3404, Transfer of Jurisdiction, Naval Oil Shale Reserves Numbered 1 and 3, (a), Transfer Required, (2) Not later than one year after the date of the enactment of this section, the Secretary of Energy shall transfer to the Secretary of Interior administrative jurisdiction over those public domain lands included within the developed tract of Oil Shale Reserve Numbered 3, which consists of approximately 6,000 acres and 24 natural gas wells, together with pipelines and associated facilities.

Sec. 3404, Transfer of Jurisdiction, Naval Oil Shale Reserves Numbered 1 and 3, (a), Transfer Required, (3) Notwithstanding the transfer of jurisdiction, the Secretary of Energy shall continue to be responsible for all environmental restoration, waste management, and environmental compliance activities that are required under Federal and State laws with respect to conditions existing on the lands at the time of transfer.

Sec. 3404, Transfer of Jurisdiction, Naval Oil Shale Reserves Numbered 1 and 3, (a), Transfer Required, (4) Upon the transfer to the Secretary of the Interior of jurisdiction over public domain lands under this subsection, the other provisions of this chapter shall cease to apply with respect to the transferred lands.

Sec. 3404, Transfer of Jurisdiction, Naval Oil Shale Reserves Numbered 1 and 3, (b), Authority to Lease, (1) Beginning on the date of the enactment of this section, or as soon as practicable, the Secretary of the Interior shall enter into leases with one or more private entities for the purpose of exploration for, and development and production of, petroleum (other than in the form of oil shale) located on public domain lands in the Oil Shale Reserves Numbered 1 and 3 (including the developed tract of Oil Shale Reserve Numbered 3). Any such lease shall be made in accordance with the requirements of the Mineral Leasing Act (30 U.S.C. 181 et seq.) regarding the lease of oil and gas lands and shall be subject to valid existing rights. (2) Notwithstanding the delayed transfer of the developed tract of Oil Shale Reserve Numbered 3 under subsection (a)(2), the Secretary shall enter into a lease under paragraph (1) with respect to the developed tract before the end of the one-year period beginning on the date of the enactment of this section.

Sec. 3404, Transfer of Jurisdiction, Naval Oil Shale Reserves Numbered 1 and 3, (c), Management, The Secretary of the Interior, acting through the Bureau of Land Management, shall manage the lands transferred under subsection (a) in accordance with the Federal Land Policy and Management Act of 1976 (43 U.S.C. 1701 et seq.) and other laws applicable to the public lands.

Sec. 3404, Transfer of Jurisdiction, Naval Oil Shale Reserves Numbered 1 and 3, (d), Transfer of Existing Equipment, The lease of the lands by the Secretary of the Interior under this section may include the transfer, at fair market value, of any well, gathering line, or related equipment owned by the United States on the lands transferred under subsection (a) and suitable for use in the exploration, development, or production of petroleum on the lands.

Sec. 3404, Transfer of Jurisdiction, Naval Oil Shale Reserves Numbered 1 and 3, (e), The cost of any environmental assessment required pursuant to the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.) in connection with a proposed lease under this section shall be paid out of unobligated amounts for administrative expenses of the Bureau of Land Management.

Sec. 3404 Transfer of Jurisdiction, Naval Oil Shale Reserves Numbered 1 and 3, (f), Treatment of Receipts, (1) Notwithstanding section 35 of the Mineral Leasing Act (30 U.S.C. 191), all monies received during the period specified in paragraph (2) from a lease under this section (including moneys in the form of sales, bonuses, royalties (including interest charges collected under the Federal Oil and Gas Royalty Management Act of 1982 (30 U.S.C. 1701 et seq.)), and rentals shall be covered into the Treasury of the United States and shall not be subject to distribution to the States pursuant to subsection (a) of such section (35). Subject to a specific authorization and appropriation for this purpose, such moneys may be used for reimbursement of environmental restoration, waste management, and environmental compliance costs incurred by the United States with respect to the lands transferred under subsection (a).

Sec. 3404, Transfer of Jurisdiction, Naval Oil Shale Reserves Numbered 1 and 3, (f), Treatment of Receipts, (2) The period referred to in this subsection is the period beginning on the date of the enactment of this section and ending on the date on which the Secretary of Energy and the Secretary of the Interior jointly certify to Congress that the sum of moneys deposited in the Treasury under paragraph (1) is equal to the total of the following: (A) The cost of all environmental restoration, waste management, and environmental compliance activities incurred by the United States with respect to the lands transferred under subsection (a); (B) The cost to the United States to originally install wells, gathering lines, and related equipment on the transferred lands and any other cost incurred by the United States with respect to the lands.

Appendix D

STANDARD LEASE TERMS AND CONDITIONS

The standard terms and conditions for oil and gas leasing are part of all federal leases regardless of other considerations. These terms and conditions automatically apply to all alternatives. All of the standard lease terms and conditions are reproduced below. Of particular consequence for managing the environmental impacts of oil and gas development is Section 6, which lays out in detail the requirements of the lessor.

"Sec. 6. Conduct of Operations. Lessee shall conduct operations in a manner that minimizes adverse impacts to the land, air, and water, to cultural, biological, visual, and other resources, and to other land uses or users. Lessee shall take reasonable measures deemed necessary by lessor to accomplish the intent of this section. ***To the extent consistent with lease rights granted****, such measures may include, but are not limited to, modification to siting or design of facilities, timing of operations, and specification of interim and final reclamation measures. Lessor reserves the right to continue existing uses and to authorize future uses upon or in the leased lands, including the approval of easements or rights-of-way. Such uses shall be conditioned so as to prevent unnecessary or unreasonable interference with rights of lessee.*

"Prior to disturbing the surface of the lands, lessee shall contact lessor to be apprised of procedures to be followed and modifications or reclamation measures that may be necessary. Areas to be disturbed may require inventories or special studies to determine the extent to impacts to other resources. Lessee may be required to complete minor inventories or short term special studies under guidelines provided by lessor. If in the conduct of operations, threatened or endangered species, objects of historical or scientific interest, or substantial unanticipated environmental effects are observed, lessee shall immediately contact lessor. Lessee shall cease any operations that would result in the destruction of such species or objects."

The "lease rights granted" as used in this section have been partially defined in the Code of Federal Regulations, part 3101.1-2, shown below. The concepts most frequently referred to in managing development operations are the potential for the authorized officer to relocate a proposed operation up to 200 meters, or to prohibit operations for a period of up to 60 days.

"A lessee shall have the right to use so much of the leased lands as is necessary to explore for, drill for, mine, extract, remove and dispose of all the leased resource in a leasehold subject to: Stipulations attached to the lease; restrictions deriving from specific, non-discretionary statutes; and such reasonable measures as may be required by the Authorized Officer to minimize adverse impacts to other resource values, land uses or users not addressed in the lease stipulations at the time operations are proposed. To the extent consistent with lease rights granted, such reasonable measures may include, but are not limited to, modification to siting or design of facilities, timing of operations, and specification of interim and final reclamation measures. At a minimum, measures shall be deemed consistent with lease rights granted provided that they do not: require relocation of proposed operations by more than 200 meters; require that operations be sited off the leasehold; or prohibit new surface-disturbing operations for a period in excess of 60 days in any lease year."

Lease Terms

Sec. 1. Rentals. Rentals shall be paid to proper office of lessor in advance of each lease year. Annual rental rates per acre or fraction thereof are:

(a) Noncompetitive lease, $1.50 for the first 5 years, thereafter $2.00;
(b) Competitive lease, $1.50; for the first 5 years; thereafter $200;
(c) Other, see attachment, or as specified in regulations at the time this lease is issued.

If this lease or a portion thereof is committed to an approved cooperative or unit plan which includes a well capable of producing leased resources, and the plan contains a provision for allocation of production. Royalties shall be paid on the production allocated to this lease. However, annual rentals shall continue to be due at the rate specified in (a), (b), or (c) for those lands not within a participating area.

Failure to pay annual rental, if due, on or before the anniversary date of this lease (or next official working day if office is closed) shall automatically terminate this lease by operation of law. Rentals may be waived, reduced, or suspended by the Secretary upon a sufficient showing by lessee.

Sec. 2. Royalties. Royalties shall be paid to proper office of lessor. Royalties shall be computed in accordance with regulations on production removed or sold. Royalty rates are:

(a) Noncompetitive lease, 12-1/2%;
(b) Competitive lease, 12-1/2%;
(c) Other, see attachment; or as specified in regulations at the time this lease is issued.

Lessor reserves the right to specify whether royalty is to be paid in value or in kind, and the right to establish reasonable minimum values on products after giving lessee notice and an opportunity to be heard. When paid in value, royalties shall be due and payable on the last day of the month following the month in which production occurred. When paid in kind, production shall be delivered, unless agreed to by lessor, in merchantable condition on the premises where produced without cost to lessor. Lessee shall not be required to hold such production in storage beyond the last day of the month following the month in which production occurred, nor shall lessee be held liable for loss or destruction of royalty oil or other products in storage from causes beyond the reasonable control of lessee.

Minimum royalty in lieu of rental of not less than the rental which otherwise would be required for that lease year shall be payable at the end of each lease year beginning on or after a discovery in paying quantities. This minimum royalty may be waived, suspended, or reduced, and the above royalty rates may be reduced, for all or portions of this lease if the Secretary determines that such action is necessary to encourage the greatest ultimate recovery of the leased resources, or is otherwise justified.

An interest charge shall be assessed on late royalty payments or underpayments in accordance with the Federal Oil and Gas Royalty Management Act of 1982 (FOGRMA) (30 U.S.C. 1701). Lessee shall be liable for royalty payments on oil and gas lost or wasted from a lease site when such loss or waste is due to negligence on the part of the operator, or due to the failure to comply with any rule, regulation, order, or citation issued under FOGRMA or the leasing authority.

Sec. 3. Bonds. A bond shall be filed and maintained for lease operations as required under regulations.

Sec. 4. Diligence, rate of development, unitization, and drainage. Lessee shall exercise reasonable diligence in developing and producing, and shall prevent unnecessary damage to, loss of, or waste of leased resources. Lessor reserves the right to specify rates of development and production in the public interest and to require lessee to subscribe to a cooperative or unit plan, within 30 days of notice, if deemed near for proper development and operation of area, field, or pool embracing these leased lands. Lessee shall drill and produce wells necessary to protect leased lands from drainage or pay compensatory royalty for drainage in amount determined by lessor.

Sec. 5. Documents, evidence, and inspection. Not later than 30 days after effective date thereof, any contract or evidence of other arrangement for sale or disposal of production.

At such time and in such form as lessor may prescribe, lessee shall furnish detailed statements showing amounts and quality of all products removed and sold, proceeds therefrom, and amount used for production purposes or unavoidably lost, may be required to provide plats and schematic diagrams showing development work and improvements, and reports with respect to parties in interest, expenditures, and depreciation costs. In the form prescribed by lessor, lessor shall keep a daily drilling record, a log, information on well surveys and tests, and a record of subsurface investigations and furnish copies to lessor when required. Lessee shall keep open at all reasonable times for inspection by any authorized officer of lessor, the leased premises and all wells, improvements, machinery and fixtures thereon, and all books, accounts, maps, and records relative to operations, surveys, or investigations on or in the leased lands. Lessee shall maintain copies of all contracts, sales agreements, accounting records, and documentation such as billings, invoices, or similar documentation that supports costs claimed as manufacturing, preparation, and/or transportation costs. All such records shall be maintained in lessee's accounting offices for future audit by lessor. Lessee shall maintain required records for 6 years after they are generated or, if an audit or investigation is underway, until released of the obligation to maintain such records by lessor.

During existence of this lease, information obtained under this section shall be closed to inspection by the public in accordance with the Freedom of Information Act (5 U.S.C. 552).

Sec. 6. Conduct of operations. Lessee shall conduct operations in a manner that minimize adverse impacts to the land, air, and water, to cultural, biological, visual, and other resources. and to other land uses or users. Lessee shall take reasonable measures deemed necessary by lessor to accomplish the intent of this section. To the extent consistent with lease rights granted, such measures may include, but are not limited to, modification to siting or design of facilities, timing of operations, and specification of interim and final reclamation measures. Lessor reserves the right to continue existing uses and to authorize future uses upon or in the leased lands, including the approval of easements or rights-of-way. Such uses shall be conditioned so as to prevent unnecessary or unreasonable interference with rights of lessee.

Prior to disturbing the surface of the leased land, lessee shall contact lessor to be apprised of procedures to he followed and modifications or reclamation measures that may be necessary. Areas to be disturbed may require inventories or special studies to determine the extent of impacts to other resources. Lessee may be required to complete minor inventories or short term special studies under guidelines provided by lessor. If in the conduct of operations, threatened or endangered species, objects of historic or scientific interest. or substantial unanticipated environmental effects are observed, lessee shall immediately contact lessor. shall cease any operations that would result in the destruction of such species or objects.

Sec. 7. Mining operations. To the extent that impacts from Mining operations would be substantially different or greater than those associated with normal drilling operations, lessor reserves the right to deny approval of such operations.

Sec. 8. Extraction of helium. Lessor reserves the option of extracting or having extracted helium from gas production in a manner specified and by means provided by lessor at no expense or loss to lessee or owner of the gas. Lessee shall include in any contract of sale of gas the provisions of this section.

Sec. 9. Damages to property. Lessee shall pay lessor for damage to lessor's improvements, and shall save and hold lessor harmless from all claims for damage or harm to persons or property as a result of lease operations.

Sec. 10. Protection of diverse interests and equal opportunity. Lessee shall: pay when due all taxes legally assessed and levied under laws of the State or the United States; accord all employees complete freedom of purchase; pay all wages at least twice each month in lawful money of the United States; maintain a safe working environment in accordance with standard industry practices; and take measures necessary to protect the health and safety of the public.

Lessor reserves the right to ensure that production is sold at reasonable prices and to prevent monopoly. If lessee operates a pipeline, or owns controlling interest in a pipeline or a company operating a pipeline, which may be operated accessible to oil derived from these leased lessee shall comply with section 28 of the Mineral Leasing Act of 1920.

Lessee shall comply with Executive Order No. 11246 of September 24, 1965, as amended, and regulations and relevant orders of the Secretary of Labor issued pursuant thereto. Neither lessee not lessee's subcontractors shall maintain segregated facilities.

Sec. 11. Transfer of lease interests and relinquishment of lease. As required by regulations, lessee shall file with lessor any assignment or other transfer of an interest in this lease. Lessee may relinquish this lease or any legal subdivision by filing in the proper office a written relinquishment, which shall be effective as of the date of filing. subject to the continued obligation of the lessee and surety to pay all accrued rentals and royalties.

Sec. 12. Delivery of premises. At such time as all or portions of this lease are to lessor, lessee shall place affected wells in condition for suspension or abandonment, reclaim the land as specified by lessor, and, within a reasonable period of time, remove equipment and improvements not deemed necessary by lessor for preservation of producible wells.

Sec. 13. Proceedings in case of default. If lessee falls to comply with any provisions of this lease, and the noncompliance continues for 30 days after written notice thereof, this lease shall be subject to cancellation unless or until the leasehold contains a well capable of production of oil or gas in paying quantities, or the lease is committed to an approved cooperative or unit plan or communitization agreement which contains a well capable of production of unitized substances in paying quantities. This provision shall not be construed to prevent the exercise by lessor of any other legal and equitable remedy, including waiver of the default. Any such remedy or waiver shall not prevent later cancellation for the same default occurring at any other time. Lessee shall be subject to applicable provisions and penalties of FOGRMA (30 U.S.C. 1701).

Sec. 14. Heirs and successors-in-interest. Each obligation of this lease shall extend to and be binding upon, and every benefit hereof shall inure to the heirs, executors, administrators, beneficiaries, or assignees of the respective parties hereto.

Appendix E

MITIGATION
COMMON TO ALL ALTERNATIVES

I. Introduction

Mitigation measures are used to reduce the environmental effects of oil and gas development. They may be attached to the lease as stipulations, such as No Surface Occupancy (NSO), Timing Limitation or Controlled Surface Use (CSU) stipulations, or as Conditions of Approval (COA) to an Application for Permit to Drill (APD).

The mitigation described in this Appendix is common to all alternatives. These measures establish a set of management objectives, development constraints, or standard operating procedures chosen by BLM to manage oil and gas on public lands. Though a particular measure may be shown in this Appendix as a lease stipulation for a new lease, BLM could choose to use the same measure as a COA on an old lease. As mentioned in Chapter 1 and Appendix B, mitigation measures must be consistent with the lease rights granted.

It is important to note that all the lease stipulations in this Appendix, with a few exceptions as noted, were approved in the FEIS and are simply being carried forward through all the alternatives in this SEIS. Those mitigation measures that differ between alternatives are discussed in Appendix F.

II. Lease Stipulations

Oil and gas leases grant the lessee the right to extract the oil and gas resource. Section 6 (see Appendix D) of the standard lease terms restricts the lease rights granted by requiring protection of other resources during development of the oil and gas. If greater resource protection is required than Section 6 can provide, lease stipulations are appended to the lease. The additional restrictions needed to protect resource values under all alternatives are shown below by type of stipulation.

Stipulations are applied by legal description to oil and gas leases on the basis of standard quarter-quarter sections (40 acres) or lots: That is, any lease parcel, containing at least a quarter-quarter section or lot, needing mitigation will have the appropriate stipulation appended to the lease document. If the parcel of land needing mitigation is smaller than a quarter-quarter section or lot, no leasing stipulation is appended to the document since a parcel that small can be avoided by standard lease terms further defined in Code of Federal Regulations, Title 43, Subpart 3101.1-2 (see discussion in Appendix D). This means that sites requiring special protection, such as a one-acre site, do not require leasing stipulations. If, however, the same one-acre site must have protection for a quarter-mile radius around the site, a leasing situation providing that protection would be written for the entire surrounding forty acre square (e.g. ¼ ¼ section).

These stipulations may be applied to all federal mineral estate regardless of surface ownership, with the exception of the federal mineral estate underlying surface administered by the U. S. Forest Service.

The regulations covering modification and waiver of stipulations are found in the Code of Federal Regulations (CFR), Title 43, Subpart 3101.1-4. Generally, a waiver, exception, or modification may be approved if the record shows that circumstances or relative resource values have changed or if the lessee can demonstrate that operations can be conducted without causing unacceptable impacts, and that less restrictive stipulations will protect the public interest.

Waivers, exceptions, or modifications can only be granted by the Authorized Officer (AO). If the proposed waiver, exception, or modification is inconsistent with the RMP, the plan must be amended to accommodate the change. Even where exceptions are not identified, they may be considered on a case-by-case basis.

Exceptions to leasing stipulations will he granted by the AO if they are consistent with the RMP. No public notice is required for exceptions to lease stipulations which conform to the plan.

Modifications to stipulations are made if the stipulation is no longer effective as written. This situation occurs when new information (for example, from a monitoring program) shows that the protective measure is unnecessarily restrictive. Modification of a stipulation requires the preparation of an environmental assessment to determine the potential impacts and plan amendment or maintenance needs. If the modification is determined by the AO to be substantial, a 30-day public notice will be given prior to modifying the lease stipulation.

Waiver means the complete elimination of a stipulation from a particular lease contract. A stipulation may be waived by the AO after an environmental assessment determines that the stipulation in question is no longer required for a particular lease. The decision to waive a stipulation requires a plan amendment and a 30-day public notice period prior to waiver.

A. No Surface Occupancy Stipulations (NSO)

The No Surface Occupancy stipulation prohibits occupancy or disturbance on all or part of the lease surface in order to protect special values or uses. It is intended for use only when other stipulations are determined insufficient to adequately protect the public interest, i.e. when analysis shows that less restrictive stipulations would be inadequate to protect the resource values in question. A NSO stipulation is not needed if the desired protection does not require relocation of proposed operations by more than 200 meters (43 CFR 3101.1-2). Lessees may exploit the oil and gas or geothermal resources under leases restricted by this stipulation through use of directional drilling from sites outside the no surface occupancy area; in some cases, the stipulation may be satisfied by addressing stated exception criteria. In the descriptions below the acreage figure in parentheses refers to the extent of the stipulation on federal mineral estate in Region 4. If there is no figure, the stipulation does not apply to Region 4 or the acreage is indeterminant and small.

1. Coal Mines. NSO covering the area of an approved surface coal mine to conserve coal resources.

Exception: This stipulation may be waived without a plan amendment if the lessee agrees that any well approved for drilling will be plugged below the coal when the crest of the highway approaches within 500 feet of the well, and that the well will be re-entered or redrilled after the completion of mining operations through the well location. A suspension of operations and production will be considered for the lease only when a well is drilled and then is plugged, and a new well or re-entry is planned when the mine moves through the location.

2. Garfield Creek, Basalt, and West Rifle Creek State Wildlife Areas. (13,234 acres) Protection of wildlife habitat values acquired by the State, including crucial big game and upland game winter habitat and concentration areas and riparian values.

Exception criteria include special mitigating measures approved by the Colorado Division of Wildlife (CDOW).

3. Rifle Falls and Glenwood Springs Fish Hatcheries. Protection of the quality and quantity of surface water and underground aquifers supplying the Rifle Falls and Glenwood Springs Fish Hatcheries within a two-mile radius of the hatcheries.

Exception criteria include special mitigating measures developed in consultation with the CDOW.

4. Grouse. NSO within one-quarter mile radius of a lek site (courtship area).

Exception: The NSO area may be altered depending upon the active status of the lek or the proximity of topographical barriers and vegetation screening to the lek site.

Note: This stipulation was modified slightly from the FEIS to remove references to species of grouse not found in GSRA.

5. Raptors (includes golden eagle and osprey: all accipiters; falcons except kestrel; buteos; and owls). NSO within one-eighth mile radius of a nest site.

Exception: The NSO area may be altered depending on the active status of the nest site or the geographical relationship of topographic barriers and vegetation screening to the nest site.

Note: Raptors that are listed and protected by the Endangered Species Act are addressed separately.

6. Bald Eagle. NSO within one-quarter mile radius of the roost or nest site.

Exception: For bald eagle roost site, the NSO applies to the essential features of the winter roost site complex. The NSO area may be altered depending on the active status of the roost or the geographical relationship of topographic barriers and vegetation screening.

No exceptions are permitted for nest sites. Section 7 consultation with the US Fish and Wildlife Service is required.

7. Peregrine Falcon. NSO within one-quarter mile radius of cliff nesting complex.

No exceptions are permitted. Section 7 consultation with the US Fish and Wildlife Service is required.

8. Mexican Spotted Owl. NSO within one-quarter mile radius of a roost or nest site.

No exceptions are permitted. Section 7 consultation with the US Fish and Wildlife Service is required.

9. Special Status Plant Species. NSO on habitat areas for those species listed by the Federal or State government as endangered or threatened, or for Federal proposed species, or as candidate species for listing. Habitat areas include occupied habitat and habitat necessary for the maintenance or recovery of the species.

Exceptions: The NSO may be altered after the AO has considered the type and amount of surface disturbance, plant frequency and density, and the relocation of disturbances, relative abundance of habitat, species and location, topography, and other related factors. Section 7 consultation with the US Fish and Wildlife Service would be required on Threatened or Endangered Species. Consultation with CDOW would be required for State listed Threatened or Endangered Species.

Note: This stipulation was modified slightly from the FEIS to include State listed species. The NSO does not affect species listed as "sensitive."

10. Major River Corridors. (1,59 acres) NSO within one-half mile either side of the high water line (bankfull stage) of the six major river corridors: Colorado, Roaring Fork, Crystal, Frying Pan, Eagle and Piney. These riverine and adjacent/associated habitats provide: 1) Special Status fish and wildlife species habitat; 2) important riparian values; 3) water quality/ filtering values; 4) waterfowl and shorebird production areas; 5) valuable habitat for amphibians; 6) high scenic and recreation values.

Exception: The NSO may be altered after the AO has considered the habitat values and the species present, the topographical and vegetative characteristics of the area and the type and

amount of surface disturbance proposed.

Note: This stipulation was modified slightly from the FEIS to specifically describe the river corridors affected (now including the Piney) and expand on the values provided by these river corridors.

11. Domestic Watershed Areas. (768 acres) Protection of municipal watersheds providing domestic water for the communities of Rifle and New Castle.

Exception: Activity may be permitted if the AO determines, in consultation with the communities of Rifle and New Castle, that the applicant's proposal would produce only a negligible decrease in water quality.

Note: This stipulation was modified slightly from the FEIS to clarify this exception.

12. Debris Flow Hazard Zone(s). NSO for the protection of the Glenwood Springs debris flow zones.

Exception: Activity may be permitted by the AO in consultation with the City of Glenwood Springs and Garfield County, provided that the applicant's proposal will produce a only negligible increase in the risk of debris flow.

Note: This stipulation was modified slightly from the FEIS to clarify this exception.

13. Colorado and Eagle Rivers SRMAs. NSO required to protect recreational and visual values.

Exception criteria include mitigating measures to: 1) screen operations from scenic viewshed; 2) make drill rig and other equipment noise unnoticeable at a distance; 3) protect recreating public from operations, and; 4) restore disturbed areas to a condition substantially unnoticeable to the casual observer.

B. Timing Limitation Stipulations (TL)

The Timing Limitation (often called seasonal) stipulation prohibits fluid mineral exploration and development activities for time periods less than a year. The dates and location(s) limiting activity are as specific as possible. A timing limitation stipulation is not necessary if it involves the prohibition of new surface disturbing operations for periods of less than 60 days (43 CFR 3101.1-2).

Timing limitations shorter than 60 days are added directly to the field operation approval as a Condition of Approval (COA) and may be noted on the lease as a Lease Notice. However, in those cases where two or more time restrictions combine or overlap to form a restriction of more than 60 days, the closure will be attached to the lease as a stipulation, as a matter of Colorado BLM policy. Additional restrictions of 60 days or less may still be added to field operations for protection of resources/values other than those stipulated.

1. Big game (includes mule deer, elk, and bighorn sheep). Protection of winter habitat which includes severe big game winter range and other high value winter habitat as mapped by the CDOW.

- Big Game Winter Habitat -December 1 to April 30

Exception: Under mild winter conditions, the last 60 days of the seasonal limitation period may be suspended after consultation with the CDOW. Severity of the winter will be determined on the basis of snow depth, snow crusting, daily mean temperatures, and whether animals were concentrated on the winter range during the winter months. This limitation may apply to work requiring a Sundry Notice pending environmental analysis of any operational or production aspects. Note: This stipulation was modified slightly from

the FEIS to remove pronghorn antelope from the list since they are not present in GSRA.

2. Big Game Birthing Areas.

- Elk calving -April 16 to June 30
- Rocky Mountain Bighorn Sheep Lambing - May 1 to July 15

Exception for Big Game Birthing Areas: When it is determined through a site-specific environmental analysis that actions would not interfere with critical habitat function nor compromise animal condition within the project vicinity, the restriction may be altered or removed.

Note: This stipulation was modified slightly from the FEIS to remove pronghorn antelope and Desert Bighorn Sheep since these species are not present in GSRA.

3. Raptors. (includes the golden eagle and osprey, and all accipiters; falcons, except the kestrel; all buteos; and owls). Raptors that are listed and protected by the Endangered Species Act are addressed separately.

- Raptor nesting and fledgling habitat - a one-quarter mile buffer zone around the nest site from February 1 to August 15.

4. Ferruginous hawk nesting and fledgling habitat. A one-mile buffer zone from February 1 to August 15 to avoid nest abandonment.

5. Osprey nesting and fledgling habitat. A one-half mile buffer zone from April 1 to August 31 to avoid nest abandonment.

Exception for raptor, ferruginous hawk and osprey (3, 4, 5 above) nesting habitat. During years when a nest site is unoccupied or unoccupied by or after May 15, the seasonal limitation may be suspended. It may also be suspended once the young have fledged and dispersed from the nest.

Note: This stipulation was modified slightly from the FEIS to better describe the habitat requirements of the species.

6. Mexican Spotted Owl.

- Mexican spotted owl nesting and fledgling habitat - February 1 to July 31.

The average Mexican spotted owl territory is estimated to encompass approximately 2,000 acres. Within this area, Primary Activity Centers (PAC's) are defined around nesting, feeding, and roosting areas within the territory. These PAC's are mapped as a 1/2 mile radius (600 acre) area around nests, roosts and the center of feeding areas and are not considered to be overlapping.

With multiple sightings of the Mexican spotted owl but with no confirmed nest or roost sites, a PAC is defined as the area where habitat is used the most.

Exceptions may be identified after formal Section 7 consultation with the U.S. Fish and Wildlife Service.

Note: This stipulation was modified slightly from the FEIS to better describe the habitat requirements of the species.

7. Bald Eagle. A one-half mile buffer zone around the nest site is required to prevent disruption of nesting from December 15 to June 15.

Exceptions may be identified after formal Section 7 consultation with the U.S. Fish and Wildlife Service.

Note: This stipulation was modified slightly from the FEIS to focus the exception on consultation with the Fish and Wildlife Service (FWS).

8. Bald Eagle Winter Roost Site. A one-half mile buffer area around the roost site to avoid relocation to less suitable areas is required from November 16 to April 15.

Exceptions may be identified after formal Section 7 consultation with the U.S. Fish and Wildlife Service.

Note: This stipulation was modified slightly from the FEIS to focus the exception on consultation with the Fish and Wildlife Service (FWS).

9. Peregrine Falcon. A one-half mile buffer area around the cliff nesting complex from March 16 to July 31 to prevent abandonment and desertion of established territories.

Exceptions may be identified after formal Section 7 consultation with the U.S. Fish and Wildlife Service.

Note: This stipulation was modified slightly from the FEIS to focus the exception on consultation with the Fish and Wildlife Service (FWS).

C. Controlled Surface Use (CSU) Stipulation

The Controlled Surface Use (CSU) Stipulation is intended to be used when fluid mineral occupancy and use are generally allowed on all or portions of the lease area year-round, but because of special values or resource concerns, some aspects of lease activities must be strictly controlled. The CSU stipulation is used to identify constraints on surface use or operations which may otherwise exceed the mitigation available under Section 6 of the standard lease terms, regulations, and operating orders. The CSU stipulation is less restrictive than the NSO or TL stipulations, which prohibit all occupancy and use on all or portions of a lease for all or portions of a year. The use of this stipulation should be limited to areas where restrictions or controls are necessary for specific types of activities rather than an activity.

No CSUs are common to all alternatives.

D. Lease Notices (LN)

Lease Notices are attached to leases to transmit information at the time of lease issuance to assist the lessee in submitting acceptable plans of operation, or to assist in administration of leases. Lease Notices are attached to leases in the same manner as stipulations, however, there is an important distinction between Lease Notices and stipulations. Lease Notices do not involve new restrictions or requirements. Any requirements contained in a Lease Notice must be fully supported in either a law, regulations, standard lease terms, or onshore oil and gas orders. Guidance in the use of Lease Notices is found in BLM Manual 3101 and CFR 3101.1-3.

If a situation or condition is known to exist that could affect lease operations, there should be full disclosure at the time of lease issuance via a Lease Notice. If a lessee may be prevented from extracting oil and gas through a prohibition mandated by a specific non-discretionary statute, such as the Endangered Species Act, a stipulation may be used even though a Lease Notice would be sufficient. It is at the discretion of the Authorized Officer whether a situation is sufficiently sensitive to warrant the use of a lease stipulation.

1. Class I and II Paleontological Areas. An inventory shall be conducted by an accredited paleontologist approved by the AO prior to surface-disturbing activities in these areas.

2. Special Status Species Areas. In areas of known or suspected habitat of special status plant or animal species, a biological inventory will be required prior to approval of operations. The inventory would be used to prepare mitigating

measures to reduce the impacts of surface disturbance on the special status species. These mitigating measures may include, but are not limited to, relocation of roads, wellpads, pipelines, and other facilities, and fencing operations or habitat.

Given the high potential for sensitive species to occur in the NOSR Production Area, it is likely that a biological inventory will be required for most of that area prior to development activities.

Note: The wording of this notice in the FEIS has been changed to reflect the change in BLM nomenclature from "sensitive" to "special status" species.

III. Conditions of Approval

All Applications for Permits to Drill (APD) are reviewed to ensure conformance with the RMP and are subject to a site specific environmental assessment (EA). Through the EA process, which includes field reviews of the proposed well, road and pipeline locations, mitigative measures are developed to reduce the adverse impacts associated with oil and gas development activities as much as possible, but consistent with lease rights granted.

These types of mitigation measures are referred to as Conditions of Approval (COA). They are developed on a case-by-case basis to address site-specific issues. COAs do not have to be approved in advance or included in the RMP, the FEIS or this SEIS for application. Any mitigation measure which is consistent with the lease rights granted and the guidance set forth in this plan and subsequent amendments is available to the AO for use as a COA.

The COAs establish common management practices employed by BLM to manage any oil and gas exploration and development activities and associated rights-of-ways. COAs are not added to applications if they are unnecessary (do not apply to the case in question) or are duplicative, as when the mitigative measure is already incorporated in the operator's submittal.

The COAs shown in this Appendix apply to all three alternatives.

A. New or Modified Conditions of Approval Since the FEIS

The FEIS (Appendix D) contains a listing of many common COAs. That list will not be repeated here. Only COAs commonly used since the FEIS or modifications of the COAs in the FEIS are shown. There is no commitment to specific wording for a COA and the Appendix is not intended to limit the development of additional COAs if needed.

1. Notification

The operator or his contractor will contact the GSRA 48 hours before beginning any work on public land. A pre-construction conference with the earth-moving contractor is required at the time of notification. The operator shall inform the Authorized Officer on a weekly basis during construction as to the status of the project.

The operator or his contractor will contact the GSRA 48 hours before starting reclamation work and within 48 hours of completion of reclamation work.

2. Big Game Habitat

To protect crucial big game winter range on leases without timing restrictions, construction and drilling activities are prohibited from January 1 through February 28. The time period could be modified or waived after a determination by the AO that the specific habitat is not being used by mule deer, or that weather conditions are

moderate, or that impacts can be mitigated to avoid abandonment of the winter range.

3. Construction

Approval may be subject to the additional measures determined at the on-site exam such as the following examples that are site specific and have been used on various APDs:

a. During construction of the access road, sidecast material will be kept to a minimum by end-hauling the material.

b. Trees and slash will be broken up and placed at the toe of the fill slope to help contain the fill.

c. Construction designs will be modified to prevent placement of fill material in the adjacent drainage, reduce the amount of fill, prevent impacts to the sensitive plants, or to protect cultural resources.

d. An interim reclamation and facilities design will be submitted and approved by the AO prior to installation of the pipeline and facilities.

e. Culverts will be installed at the elevation of the natural streambed. The length of the culvert will be sufficient to extend past fill material. The fill slopes of both the upstream and downstream sides of the culvert will be riprapped with a well graded mixture of rock sizes to prevent erosion or headcutting of the fillslopes. Installation of wings on the up and down stream ends of the culvert may be used in place of the riprap. The fill material placed over the culvert will be compacted in 6" lifts and will be a depth of at least half the diameter of the culvert.

4. Reserve Pits

The reserve pit shall be reclaimed as early as possible after completion activities or when no longer needed. Earliest reclamation of the pit would be required the same year of construction if the pit has had 90 days to evaporate through the period of May 1 to September 30. This is to ensure that re-vegetation can begin with the first available growing season after initial construction of the well pad. If reclamation of the pit is not feasible during the first year of construction, the reserve pit would be reclaimed the subsequent year the pit is no longer needed. There will be a minimum of three feet of cover (overburden) on the pit. When work is complete, the pit area will support the weight of heavy equipment without sinking.

5. Pipelines

Surface pipelines will be uncoated steel so as to blend into the visual background.

6. Drilling

All operations, unless otherwise specifically approved in the APD, must be conducted in accordance with Onshore Oil and Gas Order No. 2; Drilling Operations.

Please contact the AO at least 24 hours prior to running the surface and production casing and conducting the BOP test.

Any usable water zones encountered below the surface casing shall be isolated and protected by cementing across the zone. The minimum requirement is to cement from 50 feet above to 50 feet below each usable water zone encountered.

All open-vent exhaust stacks associated with heater-treater, separator, and dehydrator units must be constructed to prevent birds and bats

from entering them and to the extent practical to discourage perching and nesting.

Approval of this application does not warrant or certify that the applicant holds legal or equitable title to those rights in the subject lease which would entitle the applicant to conduct operations thereon.

Surface casing must be set to a depth of at least 300 feet, except in the overpressure zone (see Chapter 3 and 4, Groundwater) casing must be 1,100 feet.

All permanent on-site structures will be painted a flat, non-reflective earth tone.

The production facilities will be placed on the pad to allow for reshaping and backfilling the cut and fill slopes.

7. Reclamation

All surface disturbance would be recontoured and revegetated according to an approved reclamation plan. Reclamation would be considered successful when the objectives described in the GSRA Reclamation Policy (see Appendix I) are achieved. The policy is generally implemented, in part, with the following COAs:

a. All disturbed areas not necessary for drilling and producing operations will undergo reclamation activities after completing dirtwork and construction operations. Specifically, if the well is a producer, the surface area of the drill pad not needed for facilities or operations and unused portions of the road will be reclaimed to the standards below. If the well is not a producer and is plugged in, the following standards will also apply to final reclamation.

Revegetation: The short term objective of re-vegetation is to establish vegetation for the control of erosion and to help prevent invasion of noxious and undesirable weeds. The long term objective is to establish a self-perpetuating set of plant associations compatible with and capable of supporting the pre disturbance land use.

The following is a recommended seed mix to be used on all disturbed surfaces (typical mix to be modified as needed):

Fourwing Saltbush, Rincon	2.0
Wyo Big Sagebrush, Gordon Creek	0.5
Thickspike wheatgrass, Critana	2.0
Pubescent Wheatgrass, Luna	2.0
Western Wheatgrass, Arriba	2.0
Indian Ricegrass, Nezpar	2.0
Cicer Milkvetch, Monarch	1.0
Alfalfa, Ladak	
TOTAL	12.0

The above rate of application is listed in pounds of pure live seed (PLS)/acre. The seed will be certified and there will be no primary or secondary noxious weeds in the seed mixture. The operator shall notify the authorized officer 24 hours prior to seeding and shall provide evidence of certification of the above seed mix to the AO.

All compacted portions of the pad, road, and pipeline route will be ripped to a depth of 18 inches unless in solid rock. Prior to seeding, stockpiled topsoil (stripped surface material) will be spread to a uniform depth that will allow the establishment of desirable vegetation. All unused disturbed areas will be seeded within 24 hours after completing dirt work unless a change is requested by the operator and approved by the authorized officer. If the seed bed has begun to crust over or seal, the seed bed must be prepared by disking or some other mechanical means sufficient to allow penetration of the seed into the soil. In addition, the broadcast seed should be covered by using a harrow, drag bar, or chain.

Revegetation will be considered successful as described by the following objectives:

1. Immediate and short term. Establish desirable perennial vegetation (seed mix) by the end of the second growing season sufficient in cover and capable of renewing itself to advance to the acceptable stage of re-vegetation and the disturbed site is considered stabilized and erosion controlled.

2. Acceptable establishment. Establish an acceptable level of vegetation (seed mix and desirable invading species) by the end of five growing seasons. Re-vegetation would be considered acceptable if: 1) the disturbed site is considered stabilized and erosion controlled; 2) the desirable vegetation approximates the adjacent canopy cover; 3) undesirable vegetation is estimated to be less than 5 percent if the adjacent vegetation (undesirable) percentage is less than 50 percent. If the adjacent undisturbed vegetation composition consists of 50 percent or greater of undesirable species, then the acceptable level of undesirable species should be no greater than 50 percent of the total re-vegetated cover or as determined on a case by case basis by the AO. Undesirable plants are usually annual and tend to dominate a disturbed area. The most prevalent undesirable species likely to occur are Halogeton, Kochia, Cheatgrass, and Russian Thistle (tumbleweed), and; 4) noxious weeds are non-existent.

3. Long-term establishment: Establish a final level of re-vegetation that approximates the original pre-disturbed condition (adjacent undisturbed area) in terms of total canopy cover and composition for shrubs, grasses, and forbs. At a minimum, the shrub component should be approximately 5 percent and the forb component approximately 10 percent of the total vegetation on the reclaimed area if the adjacent vegetation is of equal or greater value for shrub and forb percentages. Final reclamation will not replace mature trees. Undesirable vegetation should meet the condition described above (2) and noxious weeds must essentially be non-existent.

b. Re-contouring. The unused disturbed areas surrounding the well location and along the road will be re-contoured to blend as nearly possible with the natural topography. Final grading of back-filled and cut slopes will be done to prevent erosion and encourage establishment of vegetation.

c. Erosion Control. All erosion associated with the operation will be stabilized and controlled. Erosion on a site will be considered controlled when water naturally infiltrates into the soil; gullying, headcutting or slumping is not observed; rills are less than 3 inches deep and deeper or excessive rilling is not observed.
If it is determined by the AO that the above reclamation standards are not being met, the operator will be required to submit a plan to correct the problem. Approval of the plan may require special reclamation practices such as mulching, the method and time of planting, the use of different plant species, soil analysis to determine the need for fertilizer, fertilizing, seed-bed preparation, contour furrowing, watering, terracing, water barring, and the replacement of topsoil.

d. Other.

Topsoil will be stripped to a minimum depth of 6". Topsoil storage piles will be no deeper than 3' to 4'. If topsoil is less than 6", the top 6" of surface material will be stripped and piled as described. The topsoil and or surface piles will be seeded within 24 hrs of stockpiling.

The operator will implement measures prior to seeding the disturbed areas after completion of the well, to enhance the productivity of the growth medium (re-distributed cut and fill soils) and the establishment of the seeded species. The type of treatment will be included in the reclamation report to be submitted to the AO. This requirement can be exempted if a soil test is

conducted and the soil has soil has sufficient nutrients and organic matter capable of supporting the seeded species.

The cut and fill slopes will be protected against rilling and erosion with measures such as water bars, lateral furrows, or other measures approved by the AO. Weed free straw bails or a fabric silt fence will be used at the toe of the fill slopes.

Areas being reclaimed will be fenced to exclude livestock until the seeded species have established. The type of fencing will be approved by the AO.

8. Riparian Areas

Stream crossings will be kept to the absolute minimum necessary and crossings will be located where riparian values are the lowest. At a minimum, crossings will not be located such that mature (late seral) riparian vegetation will be affected.

Depending on the amount of riparian vegetation disturbed, the AO may require the replanting of the area immediately after the disturbance occurs. This may include the planting of native riparian species appropriate to the site, such as willow plugs, cottonwood poles, and clumps of herbaceous riparian species.

Installation and maintenance of sediment traps may be required to collect and settle out sediments where surface disturbance is necessary in or near perennial stream channels.

B. Proposed additional new COAs

The following COAs were developed during the preparation of the SEIS and would be implemented upon completion of the SEIS.

1. Wildlife

Any activity, structure of disturbance proposed within big game migration corridors shall be implemented in such a manner that migration activities won't be disrupted or precluded.

2. Reclamation

After completion activities, the operator will reduce the size of the well pad to a minimum amount of surface area needed for production facilities while providing for reshaping and stabilization of cut and fill slopes. The cut and fill slopes will be reshaped to a maximum of 2.5:1 slopes. If 2.5:1 slopes cannot be reconstructed, the operator will submit information necessary to demonstrate that the slopes can be stabilized and revegetated to meet the GSRA reclamation goals and objectives.

If the reclamation potential of a proposed well site is determined to be very low (e.g., re-shaping of severe cut and fill slopes, very low revegetation potential etc.) through the on-site exam, the operator would be required to modify the reclamation section of the surface use plan of the APD to address and demonstrate that the problem areas could meet GSRA reclamation objectives.

3. Bonding

Additional bonding could be required for sites with extremely difficult reclamation conditions or if repeated reclamation attempts have been unsuccessful. This is more likely to occur under the following conditions: the wellpad cannot be substantially reduced in size for production facilities and the majority of reclamation (reshaping and revegetation) would not occur until the well is plugged and abandoned; large cut slopes (over 20 feet) are left on the well pad for the life of the pad; final reclamation could not be completed with standard reclamation measures as documented in the site specific environmental

analysis, and; it is determined that the nationwide bond is inadequate.

4. Reporting

Each operator shall report annually to BLM on the reclamation status of all sites subject to reclamation requirements and provide BLM information on an annual basis regarding all actions performed to accomplish reclamation goals. The report will specify if the reclamation objectives are being met or are likely to be achieved and actions needed to meet those objectives.

5. Project Rulison

All wells located within three miles of Project Rulison shall be subject to oversight measures adopted by the Colorado Oil and Gas Conservation Commission. Generally, APDs for such wells will be reviewed by the Department of Energy (DOE) for consideration if such wells should be incorporated into DOE's regular monitoring program.

6. Cattle guards

All cattle guards shall conform to BLM design and specifications. At each cattle guard a bypass gate shall also be constructed in accordance with BLM design and specifications.

Appendix F

MITIGATION ALTERNATIVES

This Appendix describes only those mitigation measures that differ between alternatives. Refer to Appendix E for mitigation measures common to all alternatives. In the descriptions below the acreage figure in parentheses refers to the extent of the stipulation on federal mineral estate in Region 4. If there is no figure, the stipulation does not apply to Region 4 or the acreage is indeterminant and small.

I. Continuation of Current Management Alternative

Note: All the stipulations shown below for the Continuation of Current Management Alternative were approved in the FEIS.

NSO Stipulations

1. Waterfowl and Shorebird. NSO on significant production areas including Waterfowl Habitat Management Areas and rookeries.

No exceptions.

Note: No such production areas exist within the GSRA.

Timing Limitation Stipulations

2. Grouse (includes sage grouse, mountain sharp-tailed, and lesser and greater prairie chickens).

- Sage grouse crucial winter habitat - December 16 to March 15

There are no exceptions.

Controlled Surface Use Stipulation

1. Fragile Soil Areas. Prior to surface disturbance of fragile soils, it must be demonstrated to the Authorized Officer (AO) through a plan of development that the following Performance Objectives will be met:

a. Maintain the soil productivity of the site.

b. Protect off-site areas by preventing accelerated soil erosion (such as landsliding, gullying, rilling, piping, etc.) from occurring.

c. Protect water quality and quantity of adjacent surface and groundwater sources.

d. Select the best possible site for development in order to prevent impacts to the soil and water resources.

Fragile soil areas are defined as follows:

Areas rated as highly or severely erodible by wind or water, as described by the Soil Conservation Service in the Area Soil Survey Report or as described by on-site inspection.

Areas with slopes greater than or equal to 35 percent, if they also have one of the following soil characteristics: (1) a surface texture that is sand, loamy sand, very fine sandy loam, fine sandy loam, silty clay or clay; (2) a depth to bedrock that is less than 20 inches; (3) an erosion condition that is rated as poor; or (4) a K factor of greater than 0.32.

Performance Standards:

All sediments generated from the surface-disturbing activity will be retained on site.

Vehicle use would be limited to existing roads and trails.

All new permanent roads would be built to meet primary road standards (BLM standards) and their location approved by the AO. For oil and gas purposes, permanent roads are those used for production.

All geophysical and geochemical exploration would be conducted by helicopter, horseback, on foot, or from existing roads.

Any sediment control structures, reserve pits, or disposal pits would be designed to contain a 100-year, six-hour storm event. Storage volumes within these structures would have a design life of 25 years.

Before reserve pits and production pits would be reclaimed, all residue would be removed and trucked off-site to an approved disposal site, Reclamation of disturbed surfaces would be initiated before November 1 each year.

All reclamation plans would be approved by the Authorized Officer in advance and might require an increase in the bond.

2. Slope greater than 40 percent. Prior to surface disturbance, an engineering/reclamation plan must be approved by the AO. Such plans must demonstrate how the following will be accomplished:

a. Site productivity will be restored.

b. Surface runoff will be adequately controlled.

c. Off-site areas will be protected from accelerated erosion such as drilling, gullying, piping, and mass wasting.

d. Surface-disturbing activities will not be conducted during extended wet periods.

e. Construction will not be allowed when soils are frozen.

Exception criteria: None.

3. Perennial water impoundments and streams, and/or riparian/ wetland vegetation zones. Activities associated with oil and gas exploration and development including roads, transmission lines, storage facilities, are restricted to an area beyond the riparian vegetation zone.

Exceptions: This stipulation may be excepted subject to an on-site impact analysis with consideration given to degree of slope, soils, importance to the amount and type of wildlife and fish use, water quality, and other related resource values.

This stipulation will not be applied where the AO determines that relocation up to 200 meters can be applied to protect the riparian system during well siting.

4. Visual Resource Management Class II Areas. Relocation of operations more than 200 meters as required to protect visual values.

Exception criteria include mitigative measures to screen operations from scenic view sheds and restoration of disturbed areas to a condition substantially unnoticeable to casual observer.

II. Maximum Protection Alternative

NSO Stipulations

1. Riparian and wetland zones. (30,870 acres) Activities associated with oil and gas exploration and development, including roads, transmission lines and storage facilities, are restricted to an area 500 feet beyond the outer edge of the riparian vegetation.

Exceptions: 1) Within 500 feet of the riparian vegetation, exceptions may be granted if the AO determines that the activity will have minimal impact on the habitat value of the riparian zone and it's associated buffer, with consideration given to the size, type and importance of the riparian area; 2) Within 100 feet of the riparian zone, an exception may be granted if the AO determines that the activity, in addition to satisfying exception criterion 1, will not

contribute to increased sedimentation into the stream channel; 3) Within the riparian vegetation, the only permitted exception is for stream crossings.

2. Wildlife Seclusion Areas. (37,671 acres) NSO within 14 seclusion areas that provide high wildlife value, eight in GMU 32: 1) The Roan Cliffs (in the NOSR Production Area); 2) Cottonwood Gulch (in the NOSR Production Area), 3) Webster Hill/Yellowslide Gulch (in the NOSR Production Area); 4) Hayes Gulch; 5) Riley and Starkey Gulch; 6) Riley Gulch; 7) Crawford Gulch; and 8) Magpie Gulch. In GMU 42, seclusion areas include: 9) Paradise Creek; 10) Coal Ridge; 11) Lower Garfield; 12) Jackson Gulch; 13) Bald Mountain; and 14) Battlement Mesa.

No exceptions are permitted.

3. King Mountain Waterfowl Area. NSO within one quarter mile of the high water mark of Grimes-Brooks, Upper and Middle King Mountain and Noble reservoirs and wetland areas around and between these reservoirs.

4. Highly Erosive Soils. (93,166 acres) NSO in identified areas of highly erosive soils, including areas identified in the RMP as Erosion Hazard Areas to minimize impacts on site productivity, adequately control surface runoff, reduce accelerated erosion and increase likelihood of successful reclamation.

Exceptions: The AO may permit exceptions for proposals at locations that: 1) will maintain the soil productivity of the site, 2) will protect off-site areas by preventing accelerated soil erosion (such as landsliding, gullying, rilling, piping, and mass wasting) from occurring, and 3) will protect water quality and quantity of adjacent surface.

5. Steep Slopes. (102,591 acres) NSO on slopes greater than 35 percent to minimize impacts on site productivity, adequately control surface runoff, reduce accelerated erosion and increase likelihood of successful reclamation.

No exceptions are permitted.

6. Site Disturbance Limit and Site Stability. (172,153 acres) On slopes greater than 25 percent, special design, construction and implementation measures, including relocation beyond 200 meters, may be required to minimize wellpad disturbance while maintaining a high probability of reclamation success. Typical wellpad size should be nor more than 2.5 acres and cut and fill slopes should be on 2.5:1 slopes.

Exceptions: The AO may permit exceptions at locations where: 1) the above performance objectives are met; 2) it can be demonstrated that a larger disturbance is required, as for multiple well bores or deeper bores, and the GSRA reclamation objectives would be achieved; or 3) it is determined that a cut slope greater than 2.5:1 would remain stable and safe (for both animals and humans) during the life of the well and additional bonding is provided to assure that the reclamation objectives will be met.

7. Water Quality Management Areas. *(24,802 acres) CSU for areas identified as* Water Quality Management Areas. To reduce erosion and sedimentation potential in watersheds identified in the GSRA RMP with water quality management concerns.

8. Semi-primitive Non-motorized Recreation Areas. (755 acres) For the protection of semi-primitive non-motorized and other recreational values, visual resources and cave resources, the following areas will be stipulated NSO.

- Deep Creek
- Bull Gulch
- Thompson Creek
- Hack Lake SRMA
- Rifle Mountain Park
- Sunlight Peak Area

- King Mountain
- Haff Ranch
- Siloam Springs
- Castle Peak
- Pisgah Mountain

In some areas, notably Sunlight Peak, King Mountain, Haff Ranch, Castle Peak, Pisgah Mountain and Siloam Springs, the NSO does not apply to the portions of the area that are already roaded.

As other areas with comparable values are identified in the BLM planning process, the NSO may be attached to those areas.

No exceptions are permitted in any of these areas.

Note: This stipulation combines several stipulations from the FEIS into one NSO and adds new public lands (Haff Ranch) and lands with revised travel management designations (Castle Peak, King Mountain, Siloam Springs) to the areas to be protected.

9. Sensitive Viewsheds. (16,753 acres) NSO on slopes over 25 percent with high visual sensitivity in the Battlement Mesa, Holmes Mesa, Interstate 70, Highway 13 and Rifle viewsheds.

Exceptions would be granted if proposed occupancy is effectively out of view, is of very low visual contrast, is not noticeable and does not attract attention.

10. Roan Cliffs Scenic Area. (14,066 acres) NSO to protect the scenic quality of the Roan Cliffs from Yellow Slide Gulch on the east of the NOSR Production Area to Hayes Gulch on the west.

Exceptions would be granted if proposed occupancy is effectively out of view, is of very low visual contrast, is not noticeable and does not attract attention.

11. Residential Areas. NSO within one-quarter mile of residences.

Exceptions: Should the occupants waive this stipulation, the AO may permit activity.

12. Sharrard Park Paleontological Area. NSO on the area of identified scientifically important paleontological resource.

Exception: The AO may permit activities that adequately mitigate impacts on the paleontological resource.

Timing Limitation Stipulations

1. Sage Grouse.

- Sage grouse crucial winter habitat - December 16 to March 15
- Sage grouse nesting habitat - March 1 to June 30

Sage grouse nesting habitat is described as sagebrush stands with sagebrush plants between 30 and 100 centimeters in height and a mean canopy cover between 15 percent and 40 percent within a 2 mile radius of an active lek.

Exceptions for nesting habitat: During years when the lek is inactive and it is determined that there is no nesting activity occurring by May 15, the seasonal limitation may be suspended.

No exceptions are permitted for winter habitat.

Controlled Surface Use Stipulation

1. Perennial water impoundments and streams. Activities associated with oil and gas exploration and development including roads, transmission lines, storage facilities, may be required to move to an area beyond 200 meters of the water source to prevent disruption of use by livestock and wildlife in areas having very limited water sources.

2. Visual Resource Management (VRM) Class II and III Areas. Relocation of operations more than 200 meters as required to protect visual values.

No exceptions are permitted.

3. Sensitive Viewsheds. Relocation of operations more than 200 meters as required on slopes under 25 percent with high visual sensitivity in the Interstate 70 viewshed to meet Class II VRM objectives, effectively screen disturbed areas from view, and maintain low visual contrast levels.

No exceptions are permitted.

Lease Notices

1. Annual Reports of Reclamation Progress. All lessees in the GSRA are required to report to the AO annually on the ongoing progress of reclamation at locations developed on the lease. (See Appendix I.)

2. Air and Water Quality Monitoring. The operator may be required to participate in water and/or air quality monitoring to establish current water and/or air quality conditions as an environmental baseline and/or monitor changes in the baseline over time. The purpose of this monitoring is to establish the contribution of oil and gas development activities to reductions, if any, in either air or water quality in the affected area.

3. Emergency Communications Plan. The operator is required to prepare and maintain a current emergency communications plan. The plan shall be provided to BLM, Colorado State Patrol, Garfield County and affected communities. The plan shall be made available to the general public upon request. The plan shall contain: information sufficient to describe the potential for emergency incidents related to oil and gas development which pose an immediate danger to human health and safety and would normally require immediate actions by the operator to remove the threat, such as for hazardous materials spills; actions to be taken by the operator in the event of such an incident; and a communications plan to inform appropriate authorities and potentially affected citizens.

4. Anvil Points Landfill. Any operations within the Anvil Points landfill area owned by Garfield County shall be consistent with the terms and conditions established in EA-CO-078-5-31.

No Lease Areas

No leasing within one mile of the Project Rulison test site.

Conditions of Approval

Wildlife

All crews should be discouraged from carrying dogs (except guard or seeing-eye dogs) and firearms while traveling to and from and while at the construction site, staging area or other facilities associated with any exploration or development operation. If dogs are present, they should be under the direct control of the employee at all times, and not allowed to run free.

Any game and/or fish violations, including harassment of wildlife, occurring on or near the lease/operation site should result in suspension or dismissal of any employee or subcontractor found in violation.

Containers used for food items should be bear proof.

Once well spacing reaches 1:160 acres in any contiguous 640 acres within a high-value wildlife area, daily well monitoring for all areas in that zone will be accomplished via remote sensing. New wells will be hooked up once the system goes on-line. For pre-existing wells, a one-year grace period to get the monitoring

system purchased, installed and tested would be allowed in areas where well spacing is already at or above this threshold spacing.

In big game winter range classified as high value or crucial, all motorized vehicle activity associated with normal daily well activities, such as monitoring and routine maintenance, will be restricted to the period between 10:00 a.m. and 3:00 p.m. from December 1 through April 30.

If a well or compressor station is located within ¼ mile of riparian zones or seclusion areas, appropriate noise mitigation (hospital muffler, vegetation screening, electric motors, etc.) will be employed to ensure that federal, state, and local noise standards are adhered to during the operation of the well.

Operators shall mitigate impacts on big game winter range when total cumulative surface disturbance reaches ten acres or more in size, as determined by the AO. Cumulative surface disturbance shall include actual impact from the proposal and surface disturbance from previous development occurring on winter range in the respective Game Management Unit. Mitigation shall include three acres of enhanced habitat for every acre of surface-disturbed habitat. Project design for enhancement work will be developed by the AO in coordination with the operator and the CDOW.

Project Rulison Monitoring. All wells located within three miles of Project Rulison shall be subject to oversight measures adopted by the Colorado Oil and Gas Conservation Commission (COGCC). Generally, APDs for such wells will be reviewed by the Department of Energy (DOE) for consideration if such wells should be incorporated into DOE's regular monitoring program.

Groundwater Risk Assessment. Inside the high-pressure zone (see Chapter 3), the operator shall provide a written assessment of the groundwater geology, which will include a description of the location of domestic wells within 1320 feet of the proposed location and a description of the actions to be taken to prevent contamination of domestic groundwater.

III. Proposed Action Alternative

NSO Stipulations

1. Riparian and wetland zones. (577 acres) Activities associated with oil and gas exploration and development, including roads, transmission lines and storage facilities, are restricted to an area beyond the outer edge of the riparian vegetation.
Exceptions: 1) An exception may be granted if the AO determines that the activity will cause no loss of riparian vegetation, or that the vegetation lost can be replaced within 3-5 years; 2) Within the riparian vegetation, an exception is permitted for stream crossings.

2. State Wildlife Areas. The Parachute Ponds State Wildlife Area is added to the list of areas receiving NSO protection.

3. Wildlife Seclusion Areas. (37,671 acres) NSO within 14 seclusion areas that provide high wildlife value, eight in GMU 32: 1) The Roan Cliffs (in the NOSR Production Area); 2) Cottonwood Gulch (in the NOSR Production Area), 3) Webster Hill/Yellowslide Gulch (in the NOSR Production Area); 4) Hayes Gulch; 5) Riley and Starkey Gulch; 6) Riley Gulch, 7) Crawford Gulch and 8) Magpie Gulch. In GMU 42, seclusion areas include: 9) Paradise Creek; 10) Coal Ridge; 11) Lower Garfield; 12) Jackson Gulch; 13) Bald Mountain; and 14) Battlement Mesa.

No exceptions are permitted.

4. Steep Slopes. (102,591 acres) NSO on slopes greater than 35 percent to minimize impacts on site productivity, adequately control surface runoff, reduce accelerated erosion and increase likelihood of successful reclamation.

Exception: The AO may make exceptions for short stretches of road or small portions of a pad. The NSO does not apply to pipelines.

5. Special Recreation Management Areas (SRMAs). For the protection of recreational values, visual resources and cave resources, the following areas will be stipulated NSO.

- Deep Creek
- Bull Gulch
- Thompson Creek
- Hack Lake SRMA
- Rifle Mountain Park

No exceptions are permitted in any of these areas.

6. Non-motorized Recreation Management Areas. (755 acres) For the protection of non-motorized recreational values, the following areas will be stipulated NSO.

- Sunlight Peak Area
- King Mountain
- Haff Ranch
- Siloam Springs
- Castle Peak

As other areas with comparable values are identified in the BLM planning process, the NSO may be attached to those areas.

Exception: Existing roads in these areas may be used for oil and gas drilling and maintenance operations.

7. Sensitive Viewsheds. (15,796 acres) NSO on slopes over 25 percent with high visual sensitivity in the Interstate 70 viewshed.

Exceptions would be granted if proposed occupancy is effectively out of view, is of very low visual contrast, is generally not noticeable and does not attract attention. These criteria all depend on the established character of the surrounding landscape.

8. Roan Cliffs Scenic Area. (14,066 acres) NSO to protect the scenic quality of the Roan Cliffs.

Exceptions would be granted if proposed occupancy is effectively out of view, is of very low visual contrast, is generally not noticeable and does not attract attention. These criteria all depend on the established character of the surrounding landscape.

Timing Limitation Stipulations

1. Sage Grouse. Sage grouse nesting habitat is described as sagebrush stands with sagebrush plants between 30 and 100 centimeters in height and a mean canopy cover between 15 percent and 40 percent within a 2 mile radius of an active lek.

- Sage grouse crucial winter habitat - December 16 to March 15
- Sage grouse nesting habitat - March 1 to June 30

Exceptions for winter and nesting habitat: During years when the lek is inactive and it is determined that there is no nesting activity occurring by May 15, the seasonal limitation may be suspended.

No exceptions are permitted.

2. Waterfowl and Shorebird Nesting Areas. This stipulation protects nesting ducks from April 15 to July 15 in a one-quarter mile buffer around the nesting and production areas of the following reservoirs: Fravert Watchable Wildlife Area, Consolidated Reservoir and the King Mountain Reservoirs - Grimes-Brooks, Nobel and Upper and Lower King Mountain.

No exceptions are permitted.

Controlled Surface Use Stipulation

1. Riparian and Wetlands Zones. In an area 500 feet beyond the outer edge of the riparian

vegetation, activities associated with oil and gas exploration and development, including roads, transmission lines and storage facilities, may require special design, construction, and implementation measures, including relocation of operations beyond 200 meters.

2. Perennial Water Impoundments and Springs. Activities associated with oil and gas exploration and development including roads, transmission lines and storage facilities, may be required to move to an area beyond 200 meters of the water source to prevent disruption of use by livestock and wildlife in areas having very limited water sources.

3. Sensitive Plant and Animal Species. For those species listed as sensitive by BLM, special design, construction and implementation measures including relocation of operations by more than 200 meters, may be required. For plant species, habitat areas include occupied habitat and habitat necessary for the maintenance or recovery of the species. For animals, habitat areas are areas that are important during some portion of the lifecycle, such as nesting/ production areas or communal roost areas (nesting areas, nests and fledging areas, dens, leks, etc.)

4. Highly Erosive Soils. Special design, construction and implementation measures may be required, including relocation of operations beyond 200 meters, in identified areas of highly erosive soils. Areas identified in the RMP as Erosion Hazard Areas are also included in this stipulation.

5. Water Quality Management Areas. CSU for areas identified as Water Quality Management Areas. To reduce erosion and sedimentation potential in watersheds identified in the GSRA RMP with water quality management concerns.

6. Site Disturbance Limit and Site Stability. On slopes greater than 25 percent, special design, construction and implementation measures, including relocation beyond 200 meters, may be required to minimize wellpad disturbance while maintaining a high probability of reclamation success. Typical wellpad size should be nor more than 2.5 acres and cut and fill slopes should be on 2.5:1 slopes.

Exceptions: The AO may permit exceptions at locations where: 1) the above performance objectives are met; 2) it can be demonstrated that a larger disturbance is required, as for multiple well bores or deeper bores, and the GSRA reclamation objectives would be achieved; or 3) it is determined that a cut slope greater than 2.5:1 would remain stable and safe (for both animals and humans) during the life of the well and additional bonding is provided to assure that the reclamation objectives will be met.

7. Sensitive Viewsheds. In order to reduce visual impacts, special design, and construction measures may be required on all lands in the I-70 viewshed and lands in the foreground and middle ground of the Battlement Mesa, Holmes Mesa and Rifle and Highway 13 viewsheds. This CSU does not include relocation of operations more than 200 meters

Lease Notices

1. Annual Reports of Reclamation Progress. All lessees in the GSRA are required to report to the AO annually on the ongoing progress of reclamation at locations developed on the lease. (See Appendix I.)

2. Emergency Communications Plan. The operator is required to prepare and maintain a current emergency communications plan. The plan shall be provided to the BLM, Colorado State Patrol, Garfield County and affected communities. The plan shall be made available to the general public upon request.

The plan shall contain: information sufficient to describe the potential for emergency incidents related to oil and gas development which pose

an immediate danger to human health and safety and would normally require immediate actions by the operator to remove the threat, such as for hazardous materials spills; actions to be taken by the operator in the event of such an incident; and a communications plan to inform appropriate authorities and potentially affected citizens.

3. **Wildlife and Wildlife Habitat.** The operator is required, in consultation with BLM and the Colorado Division of Wildlife (CDOW), to develop and implement specific measures to reduce impacts of oil and gas operations on wildlife and wildlife habitat. Such measures shall be submitted to the BLM in conjunction with preparation of APDs and/or Plans of Development. Such measures may include completing habitat improvement projects designed to replace habitat lost through construction activities; reducing human disturbance to wildlife in important habitat areas during critical times of the year by installing gates and closing roads, using telemetry to collect well data and accessing well site locations during the times of the day when wildlife are likely not to be present in the area. It is recognized that other measures may be appropriate and that not all measures would be appropriate for all areas. As such, this measure is best implemented through plans of development addressing several years activity in an area.

4. **Working in Wildlife Habitat.** The operator is encouraged to work with the CDOW to establish a set of reasonable operating procedures for employees and contractors working in important wildlife habitats. Such procedures would be designed to inform employees and contractors on ways to minimize the effect of their presence on wildlife and wildlife habitats. Procedures might address items such as working in bear country, controlling dogs, and understanding and abiding by hunting and firearm regulations.

5. **Working in Residential Areas.** The operator is required to consider the impact of operations on nearby communities and residences and will be expected to reasonably adjust operating procedures to accommodate local residential concerns. For example, the operator will be expected to try to work out reasonable compromises to related issues such as noise, dust, and traffic. The operator will be expected to address such issues when raised during public comment periods associated with preparation of environmental assessments or as complaints are reported to the operator, the BLM or the COGCC.

6. **Anvil Points Landfill.** Any operations within the Anvil Points landfill area owned by Garfield County shall be consistent with the terms and conditions established in EA-CO-078-5-31.

No Lease Areas

No such areas are proposed under this Alternative.

IV. Comparison of Alternatives

Section 2.2.4 describes the major differences between each alternative in the context of the major scoping issues identified in Chapter 1.

Appendix G

SUPPLEMENTAL WILDLIFE INFORMATION

Chapter 3
Supplemental Information

High Value Habitat Areas

Game Management Unit 32

GV Mesa. The interspersion of pinyon-juniper habitat with sagebrush provides excellent wildlife habitat, especially for wintering mule deer. Much of the Mesa is southerly in aspect, which provides open ground during the winter months on which deer can forage. The proximity of the Mesa to the alfalfa fields along Parachute Creek is important to mule deer, both in the early winter and late spring. This area has typically held high deer densities in the winter.

Hayes Gulch. This area is a winter concentration area for mule deer. Its proximity to the agricultural fields of the Parachute Creek valley is important for mule deer in the early winter and spring. The upper slopes and valley floor provide transition range. The steep slopes and roadless nature of the upper portions of the Gulch offer good seclusion/security areas for mule deer. A migration corridor for movement between summer and winter range exists in the upper reaches of the Gulch. Movement corridors such as these, are extremely important because the Roan Cliffs offer few passages that allow movement of big game animals from the top of the Roan Plateau to the valley floor. These routes provide access from winter range to summer range and vice versa. A riparian system and free water are present in the Gulch. The area is frequented by chukar and has good raptor habitat. Elk use the upper portion of the Gulch and Glover Point as a wintering area. Historically, this area has produced some trophy quality mule deer. It is also the area where an unauthorized band of aoudads were released and still tend to inhabit.

Granlee Gulch *up the east side of Parachute Creek and back down the west side to Mount Callahan (below the oil shale rim within Parachute Creek).* The vegetative diversity of this area provides excellent habitat for many wildlife species including small mammals, amphibians, reptiles, migratory passerine birds, game birds and big game. The area is relatively roadless in the upper reaches of the canyons, which provides an additional solitude component not available in many other areas. The southern aspects in this area are critical as winter foraging areas for deer and elk, especially during heavy snow years. The area also provides transition range important to mule deer. The proximity to the alfalfa fields in the main stem of Parachute Creek also makes the area important winter and spring transition range for deer. This area contains several mesic seep/ slough areas supporting riparian like vegetation that provide high wildlife value because of the free water, vegetative complexity, diversity, and their location in the drainages (they are typically up located on a steep side hill above the valley bottom). They are formed by a geologic slough of parent material that is integrated with a water source. These habitat types are uniquely important because they offer the components of a riparian system outside the confines of the valley bottom. This habitat diversity provides a wildlife diversity unique to this ecosystem. Riparian areas are critical to this area.

Roan Plateau Cliffs. This area is critical habitat for raptors. Most importantly, the 100-300 foot cliffs provide nesting habitat adjacent to open grass/forb slopes and the Colorado River riparian plain for foraging areas. The Douglas fir habitat below the rim also provides ample nesting trees and hunting perches. The proximity to the aspen and mountain shrub habitats atop the NOSR provides additional foraging areas.

West side of Parachute Creek *(below the rim)* ***and Hayes Gulch.*** This area provides important mule deer transition range and critical winter range (southerly aspects with xeric shrub and the steep slope easterly aspects of the mountain shrub community) especially during heavy snow

years. The dense Douglas fir provides thermal cover and solitude for big game animals. There is little or no road access to this area which provides a solitude and security component.

UNOCAL Agricultural lands. Mule deer use these meadows in early spring and late fall. The fields have become a critical nutritional area. Their proximity to adjacent mountain shrub and sagebrush habitats enhances their wildlife value because these fields are not available to mule deer when there is deep snow cover.

Cottonwood Gulch. The vegetation in this area is quite diverse with the upper elevations containing Douglas fir and aspen, mixed mountain shrub, juniper, and lower elevation desert scrub. The area is dissected by Cottonwood Creek which supports a mature Cottonwood riparian zone. This area provides a major migration route for mule deer through the Roan Cliffs. Seclusion values exist in much of the area, especially the remaining roadless, riparian areas and steep slopes bracketing the drainage. Bald eagle roost sites have been documented in the area (Val Grant Ph.D. pers. comm.). This area also contains transition range connecting the top of the Plateau to the winter range below the rim. The highway fence prevents big game migration to and from GMU 42.

Game Management Unit 42

Divide Creek/Mamm Creek. The interspersion of pinyon/juniper with low elevation sagebrush and mixed mountain shrub, makes this area highly productive and vital to the long term health of the wintering mule deer and elk populations in GMU 42. The relatively flat to rolling terrain with a variety of aspects but a number of low elevation southerly aspects allow for lower snow depth and warmer temperatures which are necessary during critical winter periods. Much of the area is classified as crucial habitat for either deer or elk. Turkey winter range, winter concentration areas and production areas are scattered throughout. Black bear fall feeding concentrations and year round habitat are included. Mountain lion utilize the area throughout the winter months.

Sunlight Mountain/Quaker Mesa. This higher elevation habitat provides excellent transition and summer range for both mule deer and elk. It serves as the "pulse of GMU 42 elk herd". Elk calving areas are abundant throughout the area. It is good summer bear habitat. Blue grouse and raptors are common throughout the area. A wide diversity in lush habitat types, including many small streams and mesic sites with their associated riparian values make this a very important area.

Uncle Bob Mountain/Alkali Creek. This area has a good mix of habitat types with an overall northerly aspect; however, the easterly running ridges all provide southerly aspects necessary for good winter range. The bulk of the elk wintering in GMU 42, use this area. Vegetation ranges from pinyon and juniper, sagebrush, mixed mountain shrub to aspen and high elevation conifer. West Divide Creek provides a good riparian community. The area provides excellent winter and transition range for both mule deer and elk; as well as winter solitude for elk. Black bear and mountain lion are common throughout the area. A variety of upland gamebirds and small game occur in the area. Blue grouse are common and it provides good turkey nesting and summer habitat. Raptors use the area extensively, with both Goshawk and Cooper's hawk found throughout the area. This area, along with the Van Mountain/Willow Creek area are the "pulse of GMU 42 elk herd".

Van Mountain/Willow Creek. This higher elevation habitat of mixed mountain shrub, high elevation sagebrush, aspen and conifer, provides excellent transition and summer range for both mule deer and elk. Deer fawning and elk calving areas are abundant throughout the area. It is good summer mountain lion and bear habitat. Blue grouse, turkey and other small game use the area extensively. Raptors are common throughout the area. A wide diversity

in lush habitat types, including many small streams and mesic sites with their associated riparian values make this a very important area. West Divide, Little Muddy and Mosquito Creek all provide good riparian habitat. The area provides good solitude values and along with the Uncle Bob Mountain/Alkali Creek area, serves as the "pulse of GMU 42 elk herd".

Hunter Mesa. The interspersion of pinyon/juniper with low elevation sagebrush and mixed mountain shrub, makes this area highly productive and vital to the long term health of the wintering mule deer and elk populations in GMU 42. The relatively flat to rolling terrain with a variety of aspects including a number of low elevation southerly aspects, allow for lower snow depth and warmer temperatures which are necessary during critical winter periods. Much of the area is classified as crucial habitat for both deer or elk. Turkey winter range, winter concentration areas and production areas are scattered throughout. Black bear fall feeding concentrations and year round habitat are included. Mountain lion utilize the area throughout the winter months. Small game, including cottontail and jack rabbits, as well as bobcat are found throughout the area.

Battlement Mesa. This higher elevation habitat provides excellent transition and summer range for both mule deer and elk. Elk calving areas are abundant throughout the area. This is the home of the Battlement Mesa bighorn sheep herd, providing all aspects of habitat necessary for survival. It is good summer bear habitat. Blue grouse and raptors are common throughout the area. A wide diversity in lush habitat types, including many small streams and mesic sites with their associated riparian values make this a very important area. The Battlement Mesa Reservoirs lie on the westerly end of the mesa. The bulk of this area is roadless and provides excellent winter solitude.

High Mesa/Dry Creek. The interspersion of pinyon/juniper with low elevation sagebrush and mixed mountain shrub, makes this area highly productive and vital to the long term health of the wintering mule deer and elk populations in the western end of GMU 42. The relatively flat to rolling terrain with a variety of aspects but a number of low elevation southerly aspects allow for lower snow depth and warmer temperatures which are necessary during critical winter periods. Much of the area is classified as winter concentration areas for both deer and elk and the lower elevations as crucial habitat. Mountain lion utilize the area throughout the winter months. This area, although not roadless, provides good winter solitude.

Alkali Creek/Sunnyside. The interspersion of pinyon/juniper with low elevation sagebrush and mixed mountain shrub, makes this area highly productive and vital to the long term health of the wintering mule deer and elk populations in GMU 42. The relatively flat to rolling terrain with a variety of aspects but a number of low elevation southerly aspects allow for lower snow depth and warmer temperatures which are necessary during critical winter periods. Much of the area is classified as severe winter range, winter concentration area and crucial habitat for both deer and elk Some of this area is also utilized as winter habitat by the Battlement Mesa bighorn sheep herd. Mountain lion utilize the area throughout the winter months.

Seclusion Area Descriptions

GMU 32, excluding NOSR I

Magpie Gulch. Approximately 5,097 acres in size, of which, approximately 95% occurs on public lands; lies outside of Impact Zones. The various habitat types here provide essential food, cover and water for many wildlife species. The steeper, northeast aspect areas supporting tall conifer, provide excellent raptor habitat and big game hiding and thermal cover. The unroaded areas provide a seclusion component among various habitat types that is important to many species. This area provides summer, transition and winter range for big game and is one of the

few areas were migration corridors exist from the top of the Roan Cliffs to the lower, steep slopes. The concentrations of deer in this area are greater than in many of the surrounding areas, especially during the winter months.

The southern aspects supporting shrub and pinyon-juniper communities, are critical to mule deer during severe winters, as they provide areas free from snow in which mule deer can forage. The proximity of these open, southern slopes to higher density brush and tree habitats is also critical as a cover component. This mosaic of habitat types and their proximity to each other also provide important nesting areas for gallinaceous and passerine birds and critical birthing habitat for many other wildlife species.

Roan Cliffs. Approximately 4,635 acres in size, of which, approximately approximately 30% of the mapped seclusion area occurs on public lands. It occurs from west of Rifle, throughout the Parachute drainage and west across Mount Callahan and Mount Logan. It occurs in portions of the Parachute Creek, Allen Point and Sharrard Park Impact Zones. This area provides very important nesting habitat for raptors. The 100-300 foot cliffs provide nesting habitat while the adjacent open grass/forb slopes and the Colorado River riparian plain below, provide important foraging areas. The Douglas fir habitat below the rim also provides ample nesting trees and hunting perches. The proximity to the aspen and mountain shrub habitats atop the NOSR provides additional foraging areas.

Webster Hill/Yellow Slide Gulch. Approximately 4,057 acres in size, of which, approximately 90% occurs on public lands; southerly portion lies within Sharrard Park Impact Zone and remaining occurs outside of any impact zone. This area provides prime mule deer winter range. Winter counts in this area also show high densities of deer (20+ per sq. mi.). It's significance as a wintering area is increased because mountain shrub and sagebrush communities exist adjacent to pinyon-juniper stands. This provides food and cover in close proximity. This food/cover complex is further enhanced by its proximity to open south slopes. The area has high seclusion value because it is predominately roadless. There is also a migration route through the Roan Cliffs in this area (from Golden Castle). The upper slopes, below the rim, offer excellent seclusion. Fragile soils and steep slopes are present throughout the zone.

Cottonwood Gulch. Approximately 610 acres in size, of which, approximately 70% occurs on public lands within Allen Point Impact Zone. This area has a major migration route for mule deer through the Roan Cliffs. Seclusion values exist in much of the area, especially the remaining roadless, riparian areas and steep slopes bracketing the drainage. Bald eagle roost sites have been documented in the area (Val Grant Ph.D. pers. comm). This area also contains transition range connecting the top of the Plateau to the winter range below the rim.

Hayes Gulch. Approximately 1,215 acres in size, of which, approximately 80% occurs on public lands, small portion within Parachute Creek Impact Zone but most in Allen Point Impact Zone. This area is a winter concentration area for mule deer. Its proximity to the agricultural fields of the Parachute Creek valley is important for mule deer in the early winter and spring. The upper slopes and valley floor provide transition range. The steep slopes and roadless nature of the upper portions of the Gulch offer good seclusion/security areas for mule deer. A migration corridor for movement between summer and winter range exists in the upper reaches of the Gulch. Movement corridors such as these, are extremely important because the Roan Cliffs offer few passages that allow movement of big game animals from the top of the Roan Plateau to the valley floor. These routes provide access from winter range to summer range and vice versa. A riparian system and free water are present in the Gulch. The area is frequented by chukar and has good raptor habitat. Elk use the upper portion of the

Gulch and Glover Point as a wintering area. Historically, this area has produced some trophy quality mule deer. It is also the area where an unauthorized band of aoudads were released and still tend to inhabit. Potential bald eagle roosting habitat and Mexican spotted owl habitat occur in this area.

Crawford Gulch and upper reaches of Garden Gulch. Approximately 1,215 acres in size, of which, approximately 30% of the lower portion occurs on public lands; it lies entirely within the Parachute Creek Impact Zone; This area is similar to other drainages in Parachute Creek/Roan Plateau ecosystem. It contains several mesic seep/slough areas. These gulches are important seclusion areas for mule deer, wild turkey, bear, and mountain lion, with the southern aspects providing excellent winter range for mule deer. The presence of perennial water is extremely important to wildlife in addition to the riparian habitat it creates. The proximity of the Gulches to alfalfa fields along Parachute Creek provides good spring and early winter habitat. The Gulches also have migration routes to summer range atop the Plateau. Potentail bald eagle roosting habitat and Mexican spotted owl habitat occur in this area.

Riley/Starkey Gulch. Approximately 4,580 acres in size, of which, approximately 10% occurs on public lands located in the lower portion; it lies entirely within the Parachute Creek Impact Zone. This area typifies the Roan Creek ecosystem; it has marked topographical and vegetational variety. It consists of a narrow valley with steep side slopes. A highly complex vegetation and wildlife species community occurs in this area. It contains everything from the low elevation greasewood community through sagebrush, mountain shrub and xeric shrub communities. The vegetation changes drastically from a riparian community in the bottom up through a sagebrush community, through the mountain shrub into the steep slope grass and forb community. All of this is mixed with a pinyon-juniper habitat on the drier sites and a Douglas fir community on the north slopes. Mesic seep/slough areas are important habitats that exist in this drainage. This drainage provides all types of deer range and includes migration corridors to the top of the Plateau. Several, well defined, riparian and steep slope mesic seep/slough habitats exist. The area is excellent mule deer habitat, providing summer, winter and transition ranges. The proximity to the Parachute Creek alfalfa fields is important to wild turkey and mule deer. The conifer, riparian and cliff areas provide suitable habitat for a variety of raptors. Potential bald eagle roosting habitat and Mexican spotted owl habitat occur in this area

GMU 42

Paradise Creek. Approximately 3,016 acres in size, of which, approximately 62% occurs on federal minerals. This area lies outside of Region 4, with a portion extending into GMU 43. The various habitat types here provide essential food, cover and water for many wildlife species. The steeper, northwest aspects areas supporting tall conifer, provide excellent raptor habitat and big game hiding and thermal cover. The diverse vegetation component (sagebrush, pinyon/juniper, mixed mountian shrub, aspen and spruce-fir, with some riparian habitat along Paradise Creek and the springs scattered throuhout the area provide all the essential habitat components necessary to support a wide variety of wildlife species. The unroaded areas provide a seclusion component among various habitat types that is important to many species. This area provides summer, transition and winter range for mule deer, elk, black bear and mountain lion. A migration corridor from Sunlight Peak extends down through this area to the Colorado River. Turkey and blue grouse are also abundant in this area.

Coal Ridge. Approximately 2,494 acres in size, of which, approximately 17% occurs on federal minerals. This area is primarily pinyon and juniper on the southern aspect and mixed mountain shrub on the northern aspect. It provides deer and elk winter range, some turkey

habitat and at one time, supported chukar. The southern aspect provides very important deer winter range.

Lower Garfield. Approximately 3,274 acres in size, of which, approximately 9% occurs on federal minerals and 91%. This area lies entirely on the Garfield Creek State Wildlife Area. It was acquired to protect crucial mule deer and elk winter range. It also supports a large population of Merriam's turkey. Habitat varies from sagebursh, pinyon-juniper, mixed mountain shrub, hay fields, grain food plots and a well developed riparian zone along Garfield Creek. Vehicular access is prohibited except for administrative purposes. The unroaded areas provide a seclusion component among various habitat types that is important to many species.

Jackson Gulch. Approximately 4,646 acres in size, of which, approximately 85% occurs on federal minerals. This area is primarily pinyon and juniper on the southern aspect and mixed mountain shrub on the northern aspect. Low elevation sagebrush parks are scattered throughout. The unroaded areas provide a seclusion component among various habitat types that is important to many species. This area provides crucial mule deer and elk winter habitat and also supports black bear and Merriam's turkey.

Bald Mountain. Approximately 11,107 acres in size, of which, approximately 96% occurs on federal minerals. This area includes most of the upper portion of the Garfield Creek State Wildlife Area. The aspect is generally northerly. Habitat types in this area include Douglas fir, aspen, mixed mountain shrub, high elevation sagebrush, and grass meadow communities. The important components of this zone are the diversity of habitat types and their proximity to each other and to the lower elevation winter habitats. Especially important are the mesic aspen communities and the riparian habitats including Baldy Creek, Garfield Creek and the side drainages feeding East Divide Creeks, which are utilized for birthing and nursery areas for elk and mule deer. The aspen habitat also provides a seclusion component for big game and many other wildlife species. Some of these areas offer good solitude for wildlife because of the varied and extreme topographical relief from drainage bottom to ridge top, juxtaposed with little or no road development in the aspen and Douglas fir habitats. The large blocks of habitat that are roadless are increasingly important for their seclusion value. This zone also provides the mountain shrub habitats that are used as transition range between summer and winter range by mule deer and elk. It contains all of the critical summer habitat for mule deer and elk. It is also prime summer habitat for bear and lion. The large, continuous blocks of Douglas fir and aspen proximate to riparian areas and open mountain shrub communities, provides excellent forage and nesting habitats for many raptors, and as a stopover area on their migration south. These habitats are also important to many birds and small mammals. Blue grouse are typically plentiful in this area because of the large amounts of mountain shrub. The area provides important summer range for mule deer and elk and the lower elevations include elk winter range. Turkey have been observed summering in this area.

Mosquito Creek. Approximately 382 acres in size, of which, approximately 93% occurs on federal minerals. This area has a southwesterly aspect and consists of a mix of sagebrush, mixed mountain shrub, aspen and conifer as well as riparian habitat along and other spring and mesic areas. The area provides important turkey habitat including production areas, Black bear fall concentration area, elk winter concentration area, and elk production area, blue grouse, black bear, mountain lion and good raptor habitat. .

Hightower Mountain. Approximately 3,228 acres in size, of which, approximately 60% occurs on federal minerals. This area has a north easterly aspect and consists of mixed mountain shrub, high elevation sagebrush, aspen, conifer and riparian habitat. It provides turkey winter range and production areas, black bear fall

concentration area, all aspects of elk habitat including winter and summer range and production area. It, along with the adjoining USFS land is the heart of elk production in GMU 42 (Per. Comm. Dave Freddy).

Battlement Mesa. Approximately 10,802 acres in size, scattered in several blocks along the north face of Battlement Mesa. Approximately 48% occurs on federal minerals. This area generally has a northerly aspect and consists of mixed mountain shrub, high elevation sagebrush, aspen, conifer and riparian habitat along a number of streams. A small portion of the west end is a mule deer winter concentration area. It is classified as mule deer severe winter range and crucial habitat. Black bear fall concentration areas occur in several portions of the area. The Battlement Mesa bighorn sheep herd utilizes the adjoining USFS lands. All types of elk habitat (winter range, summer range, production areas)occur here. Blue grouse are abundant, a variety of raptors, including Northern Goshawk occur here. Peregrine falcon have been sighted in the Mamm Peak area but no nest has been confirmed.

Table H-1. Habitat Importance to Major Wildlife Groups or Species

Habitat type	Mule deer	Elk	Bear	Upland Game Birds	Raptors	Reptiles	Bats
Semi-desert scrub	Food	Food		Food, Cover Nesting	Food	Food, Cover Birth	Food
Juniper Woodland	Food, Cover	Food, Cover		Food, Cover Nesting	Food, Cover Nesting	Food, Cover Birth	Food, Cover
Sagebrush	Food	Food		Food, Cover Nesting		Food, Cover Birth	Food
Mixed Mountain Shrub	Food, Cover, Birth	Food, Cover Birth	Food Cover	Food, Cover Nesting	Food, Cover, Nesting		Food
Conifer	Cover	Cover	Cover Dens	Food, Cover Nesting	Food, Cover Nesting		Cover
Aspen	Food, Cover Birth	Food, Cover Birth	Food Cover	Food, Cover Nesting	Food, Cover Nesting		
Mesic/ Riparian/ Wetland	Food, Cover Birth, Water	Food, Cover Birth, Water	Food Cover Water	Food, Cover Nesting, Water	Food, Cover Nesting Water	Food, Cover Birth, Water	Food, Cover Water
Cliffs/ Talus Slopes			Dens		Nesting		Cover
Caves/Mines							Roost, Birth

Impact Zone Description

Currently, gas development is concentrated in 5 relatively distinct areas defined as Impact Zones, which encompass approximately 183,012 acres Reference Map 3.). 96 percent of the development has occurred in these zones to date and this trend is expected to continue. Three of these Zones occur in GMU 32 with the other two in GMU 42.

Parachute Creek Impact Zone. The Parachute Creek Impact Zone is 28,897 acres in size, currently has 44 BLM administered gas wells (150 acres of surface disturbance) and 131 private gas wells (445 acres of surface disturbance). This Impact Zone extends up Parachute Creek to above the confluences of the East Middle Fork and the West Fork. This Impact Zone includes a number of important streams and riparian areas as follows: Riley,

Starkey, Crawford, and Garden Gulches, West, East Middle and East Fork of Parachute Creek, and Granlee, Helm and Hayes Gulches. Much of this Zone has been mapped as a High Value Habitat because of its importance to wintering mule deer, high habitat and wildlife species diversity and abundant riparian and water resources. It also includes six of the Seclusion Areas. Specific descriptions of the Seclusion Areas and High Value Habitat areas are found in Appendix W.

Allen Point. The Allen Point Impact Zone is 13,097 acres in size, currently has 23 BLM administered gas wells (78 acres of surface disturbance) and 87 private gas wells (296 acres of surface disturbance). This Impact Zone extends from just east of Parachute, east to Balzac Gulch and includes the Cottonwood Gulch area. About 75% of this Zone is included in the NOSR III Production Area. The area is generally very steep with relatively barren slopes. Vegetation includes juniper, some mixed mountain shrub on the northerly aspects, low growing shrubs and forbs and at the lower elevations, saltbush, greasewood and sagebrush with a cheatgrass understory. Approximately 50% of this Zone has been mapped as High Value Habitat and it includes 2 Seclusion Areas (Appendix W). The remaining 50% has been mapped as Low Value Habitat.

Sharrard Park. The Sharrard Park Impact Zone is 13,822 acres in size, currently has 29 BLM administered gas wells (99 acres of surface disturbance) and no private gas wells. It extends from Balzac Gulch, east to east of Webster Hill. About 20% of this area is included in the NOSR III Production area. This area has a southerly aspect and is also very steep, with relatively barren slopes. Vegetation includes juniper, some mixed mountain shrub on the northerly aspects, low growing shrubs and forbs and at the lower elevations, saltbush, greasewood and sagebrush with a cheatgrass understory in the flats. It is less important than the other Zones due to lack of cover, steep barren hillsides, heavy gas development in the wildlife useable terrain and wildlife access from the south is limited by the I-70 corridor.

Morrisania Mesa. The Morrisania Mesa Impact Zone is 51,570 acres in size, currently has 43 BLM administered gas wells (146 acres of surface disturbance) and no private gas wells. It extends from Pete and Bill Creek, east to Flat Iron Mesa. The topography is rolling and it is dissected by several major streams. Vegetation varies from sagebrush and juniper at the lower elevations up through mixed mountain shrub into aspen and Douglas fir. The aspect is generally northerly. It is very important to wildlife because of its diversity, relatively gentle slope and ample water.

Mamm Creek. The Mamm Creek Impact Zone is 75,626 acres in size, currently has 15 BLM administered gas wells (51 acres of surface disturbance) and 130 private gas wells (442 acres of surface disturbance). It extends from Flat Iron Mesa, east to Kamm Mesa. The topography is rolling and it is dissected by several major streams. Vegetation varies from sagebrush and juniper at the lower elevations up through mixed mountain shrub into aspen and Douglas fir. The aspect is generally northerly. It is very important to wildlife because of its diversity, relatively gentle slope and ample water.

Mountain Lion

The 1995 quota for mountain lion was 10 animals. Lion harvest data from 1981-1994 shows an average of four animals killed per year. Historic reports show only two lion harvested between 1968 and 1973. Damage complaints from lion depredation on domestic sheep are not uncommon in the eastern portion of GMU 32. Losses from sheep have approached $5,000 in one spring (lambing) season. In GMU 42, The 1995 quota for mountain lion was 4 animals and the quota was met; however, in the recent past, harvest has been closer to one per year.

Black Bear

In GMU 32, bear harvest reports from 1979-1994 show an average kill of four animals per year. The high harvest year was 1985 with 11 animals. No bear have been reported harvested in the GMU for the years 1993 and 1994. Historic reports show the estimated annual black bear kill for the period 1950-1972 inclusive was 3.4, based upon hunter report card surveys (McKean and Neil 1974). Bear sightings and reports of damage increased from 1993 to 1995 on the NOSR. The NOSR has been the site of several damage complaints from bear depredation on domestic sheep. These claims have approached $5,000.

Raptors

The table below lists the habitats used by the various species of raptors for their nesting, hunting and roosting needs.

Table H-2. Habitat Use by Raptors

Species	Grassian Fields	Semi-desert scrub, Sagebrush	Juniper Woodland	Mixed Mountain Shrub	Conifer	Aspen	Mesic/ Riparian	Cliffs
Golden Eagle	Hunt	Hunt	Hunt, Nest	Hunt	Hunt			Nest
Bald Eagle	Hunt	Hunt	Hunt	Hunt	Roost		Roost, Nest	
Falcons, Peregrine/Prairie	Hunt	Hunt		Hunt		Hunt	Hunt	Nest
Redtailed Hawk	Hunt	Hunt	Hunt	Hunt		Hunt	Nest, Hunt	Nest
Northern Harrier	Nest, Hunt							
Osprey							Nest, Hunt	
Ferruginous Hawk	Nest, Hunt	Nest, Hunt						
Swainson's Hawk	Nest, Hunt	Nest, Hunt	Nest, Hunt	Nest, Hunt				
Kestrel	Hunt	Hunt	Nest					Nest
Cooper's Hawk			Nest, Hunt		Nest, Hunt	Nest, Hunt	Nest, Hunt	
Sharpshinned Hawk			Nest, Hunt	Nest, Hunt	Nest, Hunt	Nest, Hunt	Nest, Hunt	
Turkey Vulture	Hunt	Hunt	Hunt	Hunt				Nest
Great Horned Owl		Nest, Hunt	Nest, Hunt	Nest, Hunt	Nest, Hunt	Nest, Hunt	Nest, Hunt	Nest, Hunt
Long Eared Owl					Nest, Hunt	Nest, Hunt	Nest, Hunt	
Western Screech Owl				Nest, Hunt			Nest, Hunt	
Flammulated Owl					Nest, Hunt			
Northern Saw Whet Owl					Nest, Hunt	Nest, Hunt		
Northern Pygmy Owl					Nest, Hunt	Nest, Hunt		
Boreal Owl					Nest, Hunt	Nest, Hunt		
Mexican Spotted Owl					Nest, Hunt	Nest, Hunt		
Burrowing Owl	Nest, Hunt	Nest, Hunt						

Specific Raptor Information

Golden eagles nest in many of the cliff complexes in Region 4 as well as in tall conifers. The Roan Cliffs along the Colorado River and the Parachute Creek drainages have numerous documented golden eagle nests. Approximately 70 nests have been documented in Region 4 with a preponderance of them in the Roan Cliffs

Common ravens are fairly common residents throughout Region 4. They typically nest on cliff ledges in stick nests. One nest has been documented in the Region.

Red-tailed hawks are one of the more common raptors found in the GSRA. They nest in a variety of habitat types, including cliff ledges, aspen, conifer and cottonwood riparian areas and are found in most of the same places as golden eagles. At least 23 nests have been documented in Region 4.

Turkey vultures are fairly common in Region 4 and nest in broken country on ledges in rocks or adobe hills; however, only one nest has been documented.

Prairie falcons are rare in the GSRA but are known to nest in several different locations, typically on cliff ledges. In Region 4 they are known to nest along the face of the Roan Cliffs with 3-4 nests being documented.

Swainson's hawk is rare in this area, being found occasionally on the Battlements and along the Hogback, the Roan Cliffs and in the Grand Valley. Swainson's hawk typicallyly nests in small islands of woodlands or mixed mountain shrub in relatively open meadow/grassland communities.

American kestrels are abundant in the area, nesting from the aspen forests down to the shrub-steppe desert. It is a secondary cavity nester and ususally nests near the edge of the forest or in small islands of woods in open areas. They are commonly seen hunting along roadways and fields in Region 4.

Cooper's hawk is a rare to uncommon summer resident of Region 4. Eight nests are documented in Region 4 and have been located in cottonwood, pinyon/juniper, oak and aspen stands.

Sharp-shinned hawks are uncommon and usually associated with boreal forests. In this area they are likely to be found in steep douglas fir forest.

The ***northern harrier*** is more typically associated with open grassland, fields and adjoining sagebrush habitats. It is relatively uncommon in Region 4.

Osprey are known to nest along the Colorado River in Debeque Canyon and at Sweetwater lake. They nest in tall cottonwood, conifer and on ledges and are always associated with lakes and rivers.

The ***great horned owl*** is a relatively common nocturnal raptor. In the area it nests in riparian to spruce/fir forest. Two nests have been documented, one on East Divide Creek and one on Grass Mesa.

The ***long-eared owl*** is a rare resident. It nests in old corvid nests and natural cavities in woodland, conifer, riparian and rimrock areas. Two nests have been documented in the Parachute Creek drainage.

The ***western screech owl*** is typically associated with the cottonwood riparian zone in this area especially along the Colorado River.

The ***flammulated owl*** is typically found nesting in mature aspen stands, often mixed with conifer.

The ***northern saw-whet owl*** is associated with woodland edges.

The ***northern pygmy owl*** is typically associated with Douglas fir and aspen stands in this area.

The ***boreal owl*** is associated with high elevation conifer forests. They have been documented in Region 4 on USFS managed lands in the Quaker Mesa area and on the Roan Plateau. It is considered a sensitive species by the USFS.

Grouse

Blue grouse are typically associated with the aspen/conifer and mixed mountain shrub communities occurring at the higher elevations. They are common throughout the Roan Cliffs, Battlement Mesa and Uncle Bob Mountain and not likely to be significantly impacted.

Sage grouse occur across the Roan Plateau; however, their population is dwindling and their status is uncertain. They summer in the sagebrush uplands and historically have wintered in the low elevation sagebrush areas along the Colorado River, with most recent records showing use in the County Line Allotment and Sunnyside area. Their documented habitat is minimal in the areas most likely to be developed and thus not likely to be significantly impacted.

Predators and Furbearers

Coyotes, weasels, badgers *and* ***skunks*** are relatively common throughout Region 4 whereas red and gray fox are less common. They all are opportunistic feeders with rabbits, small rodents and birds composing the bulk of their diet.

American marten inhabit sualpine spruce-fir and lodgepole pine forests in this area. Their food base consists mostly of mice and voles; however, rabbits and small squirrels are also utilized.

Beaver, mink *and* ***muskrat*** are all found in conjunction with flowing streams and ponds. Beaver and muskrat are dependent upon riparain and wetland vegetation for food while mink are predators, feeding primarily upon muskrat, rabbits, mice, voles and ground nesting birds.

Chapter 4
Supplemental Information

Indirect Impacts on Big Game

Displacement results in underuse of habitat near disturbances (loss of habitat value), overcrowding on the remaining habitat, increased competition for space with other species, areas of overuse, and decreased physical condition of the population. Other effects of the associated increased stress and harassment may include a reduction in reproduction rates, and increase in winter mortality due to increased energy use. Increased expenditures of energy are particularly significant during severe winter conditions and often result in a higher mortality of fawns when this mortality is already high due to natural conditions. Displacement effects result in overall reductions in habitat carrying capacity. Although the physical habitat is still present, the animals use it to a much lesser extent than before the disturbance. Loss of carrying capacity may in turn result in long-term reductions in big game populations, especially if alternative habitat areas are unavailable or already fully occupied. Displacement is of greatest concern in areas which have been recognized as crucial habitat areas essential for the maintenance of the local population. Disturbance reduces habitat utility and the capacity of affected acreage to support wildlife populations. The value of the habitat near the disturbance is decreased and does not support the same level of use as long as the disturbance remains.

Displacement or loss of habitat value for big game has been documented by numerous researchers (Lyon 1985, Ward 1976, Ward et al. 1980, Rost and Bailey 1979). These researchers found that disturbance associated with the presence of humans and traffic on roads, reduces the use of habitat by big game adjacent to the activity. The distance big game move away from these activities ranges from 200 meters (1/8 mile) for deer to well over 800 meters (1/2 mile) for elk. Impact levels are dependent on the intensity, frequency, and duration of the activity, location, time of year, species involved, and animal perception as modified by experience and topographic or vegetative screens. Impacts are most severe on delineated crucial habitats during sensitive timeframes.

The actual distance big game move to avoid vehicle traffic and other human disturbance is influenced by slope, topography, degree of vegetative cover that may screen the disturbance and intensity of the disturbance.

Most species of big game are known to adapt to human related disturbances to some degree. For example, deer would adapt to heavy traffic associated with paved roads and characterized as constant speed with no-out-of-vehicle human activity (Ward et al. 1980, Ward 1976, Richardson 1992). Several factors influence the likelihood of big game populations to adapt to human related disturbances. Non-migratory and non-hunted populations of big game are more likely to adapt than migratory or hunted populations. (Note that mule deer and elk populations in Region 4 do <u>not</u> fit in this category because they are both migratory and are hunted-.) Even if big game do adapt to roads and vehicles, it is disadvantageous during the hunting season and allows for a greater illegal harvest. Based on these factors specific to Region 4, big game are not expected to readily adapt to the human related disturbances associated with the gas field operations.

Cumulative Impacts to Date

The Colorado River valley had intensive, long term, grazing as early as the 1850's with portions of the valley being heavily overgrazed during the first half of the 20th century. Many of these areas have not recovered, resulting in a conversion of these areas to annual weedy species. Many areas still receive winter and early spring livestock grazing in crucial big game winter range thus creating direct competition for forage on these areas. Much of the current vegetation on the remaining undeveloped winter range consists of dense, over mature to decadent shrubs with a sparse understory of annual plant species. The resultant carrying capacity is much reduced for both big game and livestock.
Fire suppression throughout most of the GSRA has allowed many vegetation types to proceed toward climax resulting in over-mature and decadent stands of vegetation. These stands are typically less productive as wildlife habitat. Most notably affected are the semi-desert scrub, mixed mountain shrub and pinyon-juniper habitats types.

The Uranium Mill Tailings Remedial Action (UMTRA) project removed a substantial habitat and forage base for big game in the short term; however, the off-site mitigation for UMTRA appears to have been very successful in providing a replacement habitat type with increased plant vigor and production.

Oil shale development caused large-scale habitat loss and habitat disturbance. The concomitant increase in human population impacted wildlife populations through increased hunting, poaching and other recreational activities. On the positive side, oil shale exploration and development also provided baseline biological and geophysical analysis at an ecosystem scale, initiated off-site mitigation for wildlife values, and implemented some successful reclamation.

Appendix H

RECREATION MANAGEMENT OBJECTIVES

- H-1 Visual Resource Management
- H-2 Recreation Opportunity Spectrum

H-1 Visual Resource Management

Visual resource management (VRM) classes are established by RMP decisions to identify visual quality management objectives for public lands. The VRM classes reflect the scenic quality, visual sensitivity and viewing distance of the landscape and prescribe the visual contrast tolerances for landscape modifications caused by management activities. The Classes range from Class I to Class V, with Class I areas being the most protective.

VRM Class I

These areas have high scenic quality, with unique and relatively scarce landscape features that are essentially natural and free of manmade landscape modifications. The management goal for these areas is to preserve their natural landscape character. Visual contrast of management activities should be very low and basically unnoticeable. This management Class is usually applied to an Area of Critical Environmental Concern (ACEC) for natural scenic values or wilderness areas. None of the lands in Region 4 are presently under this protective management Class, located in portion of the Bull Gulch WSA.

VRM Class II

These areas have high scenic quality, with high variety in the landscape features. They are highly visible and highly sensitive to landscape modifications. The management goal for these areas is to retain their landscape character. Visual impact of management activities must blend in with the natural landscape. Visual contrast of management activities must be low and not attract attention. Approximately 107,476 acres are under this Class, including the foreground mesa slopes along I-70, the Roan Cliffs and related footslopes west of Rifle, Garfield Creek valley southeast of Silt, the mountain slopes below Mud Hill and around Flat Iron Mesa, and the headwater canyons of Parachute Creek.

VRM Class III

These areas have Class B scenic quality, with moderate landscape variety and a few outstanding features. They may be moderately to highly visible, with moderate visual sensitivity. The management goal for these areas is to partially retain their landscape character. Visual impact of management activities may be evident and visual contrast may be moderate but not dominate the natural landscape character. Approximately 164,933 acres are under this management Class, including the upper slopes of Battlement Mesa, the Roan Cliffs footslopes northwest of Rifle, the plateau above the Roan Cliffs, the Divide Creek valley and the rolling hills in Cactus Valley north of Silt.

VRM Class IV

These areas have Class C scenic quality, with low landscape variety. They receive low to moderate viewing volume, and visual sensitivity is low. The management goal for these areas is to allow modification of the landscape character as needed to accommodate management activities. Visual impact of landscape modifications may be evident and visual contrast may be moderate to high. Development may introduce dominant features in the natural landscape. Approximately 137,967 acres are under this management Class, including most of the sagebrush and woodland covered mesas and drainages west of Parachute, the lower and middle Parachute Creek canyon and sideslopes, the rolling foothills and mesas north and west of Rifle, most of Grass Mesa and the slopes above Holms Mesa, and the hills and mesas east of Divide Creek.

VRM Class V

These areas may be in places with Class A or B scenic quality which have been severely modified by development activities. This is an interim classification with the management goal of restoring the modified landscape to the appropriate VRM Class standards. Approximately 4,380 acres are under this management Class, including sites in Parachute Creek, Anvil Points and JQS Road.

H-2 Recreation Opportunity Spectrum

Recreation Opportunity Spectrum (ROS) Class Definitions

ROS classes are established by RMP decisions to identify management objectives for the type of recreational experience and the quality of recreational settings which will be provided on public lands for a variety of outdoor recreational activities. ROS classes for public lands generally range from primitive to semi-urban or rural, with the more primitive areas relying on an essentially unmodified natural environment. ROS classes are normally considered during review of proposed management actions to determine if they are consistent with the recreation management objectives and to identify possible mitigation measures.

Primitive. These areas provide opportunities for visitors to experience isolation from the sights and sounds of man, to feel a part of the natural environment, experience a high degree of challenge and risk, and use outdoor skills. These areas are remote, generally over three miles from a primary road and over a half mile from other motorized routes. Travel is limited to non-motorized means, and is mainly cross country or on unimproved paths. The setting is characterized by essentially unmodified natural environment. source manipulations are few and largely unnoticeable. Visitor densities are very low, and there is very little evidence of other users. Visitor encounters are infrequent, generally no more than one to two per day. Visitor management restrictions, controls, structures or facilities are not evident or provided within the area, except for those essential for resource protection and safety. Facilities for comfort or convenience of users are not provided.

Semi-Primitive Non-Motorized areas. These areas provide some opportunities to experience isolation from the sights and sounds of man, and have a high degree of interaction with the natural environment, but not as intense as in a Primitive area. They also provide opportunities to have a high degree of interaction with the natural environment, take risks and use outdoor skills, but these are not as valuable as in a Primitive area. These areas are somewhat remote, generally over half a mile from any motorized route. Travel is limited to non-motorized means, and improved trails may be provided. The settings are characterized by a predominantly unmodified natural environment. Resource manipulations may be encountered over most of the area but they are subtle and only a few are noticeable. Concentration of users is low, and there are few signs of other visitors.

Visitor encounters are more frequent than in a primitive area, but generally no more than five other parties per day near access points. Visitor management restrictions, controls, structures or facilities may be provided for resource protection and safety, but they are subtle. Recreation site improvements are very limited and rustic, and made of native materials wherever possible. Facilities for comfort or convenience of users are not provided.

Semi-Primitive Motorized areas. These areas provide some opportunities for visitors to experience isolation from the sights and sounds of man, but they are not as important as in non-motorized areas. They provide opportunities to

have a high degree of interaction with the natural environment and take moderate challenges and risks. They also provide opportunities to use outdoor skills. These areas are generally removed from secondary highways, but are readily accessible by motorized vehicle. Access roads are primitive and generally passable only by high clearance or 4WD vehicle, or OHVs. Typical roads are single lane dirt surfaced and rough. Road maintenance is minimal to keep them passable, and limited to removal of obstructions and provision of adequate drainage. The settings are characterized by a predominantly unmodified natural environment. Resource manipulations may be encountered over most of the area; however, most of them are subtle. Some may be noticeable. Concentration of users is low, with some signs of other visitors. Visitor encounters are relatively frequent, but generally less than 10 other parties per day along travel routes. Visitor management restrictions, controls, structures or facilities may be provided for resource protection and safety, or in a few instances to enhance recreation opportunities. Recreation site improvements are subtle, limited and rustic, and made of native materials wherever possible.

Roaded Natural. These areas provide about equal opportunities for affiliation with other visitors and to experience isolation from the sights and sounds of man. Opportunities for a high degree of interaction with the natural environment are available, but opportunities to take challenges and risks are not very important except for specific activities. These settings are characterized by a generally natural environment, and evidence of rural residences and agricultural land uses are found over most of the area. Resource manipulations are noticeable throughout the area and are harmonious with the natural environment; some substantial modifications may be encountered. These areas are along primary roads and are accessible to standard passenger vehicles. Road maintenance is regular and relatively frequent. Concentration of users may be high, and evidence of other users is common. Visitor encounters are frequent along travel routes and recreation sites. Visitor management restrictions, controls, structures or facilities may be provided for resource protection and safety, for user convenience and to enhance recreation opportunities. Recreation site improvements may be developed to accommodate specific recreational uses or special activities.

Semi-Urban/Rural Areas. These areas provide opportunities to participate in specific recreation activities and a natural setting is not as important. Opportunities to experience challenge, risk taking and use of outdoor skills is also unimportant, except for special activities which may involve challenge and risk. These activities may require special skills. These areas are along primary roads and are accessible to standard passenger vehicles. Road maintenance is regular and frequent. These settings are characterized by a substantially modified natural environment. Landscape modifications and a variety of land uses are obvious. Resource manipulations are substantial and widespread. Concentration of users may be high, and evidence of other users may be everywhere. Visitor encounters are frequent throughout most of the area. Visitor management restrictions, controls, structures or facilities may be provided for resource protection and safety, for user convenience and to enhance recreation opportunities. Recreation site improvements may be developed to accommodate high use volume for specific recreational uses or activities.

Appendix I

SURFACE RECLAMATION

- I-1 Summary
- I-2 Reclamation Status
- I-3 GSRA Policy

What is Surface Reclamation?

Surface reclamation for oil and gas development activities is a process of reducing the impacts of ground disturbance associated with construction and operation of gas well pads, road, pipelines and associated facilities. Reclamation measures are required of all oil and gas operators. Specific reclamation requirements at any location will vary depending on the nature and extent of the disturbance, site-specific reclamation goals and objectives, and conditions at the site, including the nature of the soils, topography, aspect, surrounding vegetation and climatic factors.

Glenwood Springs Resource Area Policy for Reclamation Related to Oil and Gas Development

The Glenwood Springs Resource Area has always required oil and gas operators to perform reclamation activities and taking steps to reduce the need for reclamation. Such measures often include storing topsoil, implementing runoff, erosion, and sedimentation control, preparing the site for reseeding with an established seed mix, and controlling noxious weeds. Avoiding areas with high erosion potential, such as soils with a high alkaline or salt content, and areas with saturated soils, such as seeps and wetland or riparian areas can reduce the need for costly reclamation measures as well as reduce the extent of the initial disturbance.

As the intensity and extent of natural gas development on BLM lands in the resource area have increased, especially in the last 5 years, the interest in and discussion of reclamation standards has also increased, both internally as well as externally.

The Glenwood Springs Resource Area formally established a written policy to document reclamation goals and objectives for oil and gas activity and to clarify expectations of oil and gas operators relative to reclamation success on July 18, 1997. This policy will be implemented for all oil and gas activities for all BLM lands, including federal mineral estate managed by the BLM, unless otherwise directed by a surface owner (in the case of a split-estate) in a surface use agreement. The guidelines cannot be required by the BLM on any lands where the minerals are not federally owned. That policy is restated below:

Reclamation goal. The reclamation goal is to control erosion on the site and establish desirable (seeded and native) vegetation to set the stage for natural processes to restore the site. The oil and gas operator will implement any/all reasonable and prudent practices necessary to achieve the reclamation goal.

Reclamation objectives. Erosion on a site will be considered controlled when water naturally infiltrates into the soil; gullying, headcutting or slumping is not observed; rills are less than 3 inches deep; and deeper or excessive rilling is not observed. The site will be photographed to document the presence or absence of gullies, headcuts, slumps or rills and observations noted.

Desirable vegetation on a site will be considered established when:

*1. **No noxious weeds are present.*** Noxious weeds are listed on the county and state noxious weed lists. All noxious weeds will be treated. On a case-by-case basis, it may be necessary to treat adjacent lands in order to prevent the spread of noxious weeds onto reclaimed sites.

*2. **Undesirable vegetation comprises little*** (less than 5%) ***of the species composition on sites with three or more growing seasons.*** On sites with one or two growing seasons post treatment, some undesirable vegetation is expected, but it will be considered a problem only when there is no emergence of the planted species. For this objective, desirable vegetation is native species or species included in the seed mix.

*3. **Desirable vegetation*** appears ***vigorous and self sustaining.*** The plants have the opportunity to complete their annual life cycles. This objective will be evaluated by observing the size, color and vigor of the plants, and noting the presence of new growth shoots, flowers, seeds, litter build-up, and seedlings.

*4. **Adequate diverse vegetation is present.*** The site appears to be fully occupied with primarily desirable vegetation and contains a mixture of grasses, forbs, and shrubs. Ideally, a good grass cover with an estimated 10% forbs and 5 to 10% shrubs would be present and the canopy cover of the reclaimed site should be equal to or greater than similar sites on the adjacent undisturbed area.

The Reclamation Timeline. A site goes through four distinct stages from initial disturbance to restoration. A site can be in more than one stage of reclamation. For example, most of a site could be in the "operator reclamation in progress" category while the production area could be in the "area in use" category. The stages of reclamation are:

*1. **Area in Use.*** At first this is the entire site. After drilling is complete and the site is in production, this area includes the road surface, production facilities, and the associated vehicle access areas.

*2. **Operator Reclamation in Progress.*** It is the intent of this policy that the operator implement reclamation practices as soon as possible after disturbance and every year thereafter as necessary to achieve the reclamation objectives. Most of the sites on the GSRA are in this category. These sites range from recently contoured and seeded, to almost reclaimed. These sites are where most of the reclamation work is being done. These sites are also the priority for monitoring.

This category is split into the "monitor" and "acceptable" sub-groups. When most of the reclamation objectives are not being met the site is in the "monitor" group. When most of the reclamation objectives are being met the site is in the "acceptable" group.

The sites in the "Operator Reclamation in Progress" category plus the "Area in Use" category equal the total "unreclaimed" acres.

*3. **Operator Reclamation Complete.*** Operator has successfully completed the required reclamation practices. The reclamation objectives have been achieved for two consecutive years. The operator has completed his reclamation responsibilities. Periodic monitoring of these sites will continue until they are abandoned by the operator. The western GSRA sites would likely be in this category for many years, depending on the weather and the site's potential.

The sites in the "Operator Reclamation Complete" category plus the sites in the "Operator Reclamation in Progress" and the "Area in Use" categories equal the total acreage presently modified by oil and gas activity.

*4. **Restored.*** Successional processes no longer associated with oil and gas development are the dominate site modifiers, and the site is no longer distinctly different from the surrounding area. In the harsh and arid environment of the western portion of the resource area, and because perennial species were planted as a reclamation practice, it is likely that sites would not be considered restored any sooner than 20 years after disturbance.

Monitoring methods. To evaluate achievement of the objectives and determine the stage of reclamation, canopy cover by species will be measured or estimated and a 3 foot x 3 foot grid will be photographed at representative locations on the site and adjacent undisturbed areas. The site will be diagrammed. A site form will be filled out. BLM will monitor reclamation status as necessary to ensure operator compliance with the APD, but the operator will also have new

responsibilities for monitoring and reporting reclamation success (see below).

Evaluation of current reclamation. The results of the monitoring will determine whether and to what degree the objectives are being achieved and thus form the basis for necessary follow up actions, such as re-treatments, determination of the reclamation categories, and releasing the operator's bond. This monitoring information should also be considered when developing reclamation plans for future APDs.

Operator reporting. Each operator shall report annually to the BLM the reclamation status of all sites categorized as "operator reclamation in progress." The purpose of this reporting is to document the operator's compliance with reclamation stipulations in the APD, reclamation practices implemented, and the success of those practices. These reports will help BLM set or adjust monitoring priorities and improve its reclamation practices and objectives. The GSRA, operators, and COGCC will collaborate to ensure consistency in reporting and methodology and avoid duplication.
Note: This portion of the policy has yet to be implemented but BLM plans to meet with the Colorado Oil and Gas Conservation Commission and the lease holders during 1998 to develop this reporting requirement.

Reclamation considerations in the EA. The BLM will specifically assess the probability of achieving the reclamation objectives. To do this, we'll compare the site proposed in the APD with comparable sites already constructed. For those sites where reclamation success is anticipated to be more difficult based on previous experiences, BLM will require a site specific reclamation plan be prepared by the operator. When the proposed site is comparable to sites where reclamation has not been successful, the operator will have to show the current sites can be successfully reclaimed prior to approval of the new APD. The reclamation policy established reclamation objectives, described desirable vegetation, set up a reclamation timeline, discussed monitoring methods, described how reclamation success will be considered relative to future APDs and required operator reporting of reclamation practices.

Why is Reclamation Important?

Reclamation is important because it reduces the environmental and social impacts of oil and gas development. Reclamation becomes increasingly important as the number of wells in an area increase and the cumulative impacts of this activity become more apparent. Refer to the SEIS for more information on the environmental effects of oil and gas development.

Throughout the scoping phase of this SEIS, many public comments addressed concerns with the success of reclamation. Many feel that while oil and gas development in the area is inevitable due to the oil and gas leases already issued that successful reclamation is critical and would result in less overall impacts; natural systems would be impacted less and the land would look better.

How is Reclamation Accomplished?

Prior to disturbance, operators and the BLM conduct on-site inspections to determine the suitability of a proposed well pad location and/or road or pipeline alignment, and to develop site specific reclamation measures.

These measures would be incorporated into the surface use plan submitted with the APD or incorporated as COAs on the APD. The surface use plans contain site specific erosion control, revegetation, restoration, and monitoring procedures; provide information on project administration, time frames, and responsible parties; contain reclamation objectives (interim and permanent); include methods to reduce the disturbed area (e.g., reduce well pad size, round corners, utilize existing disturbed sites, use dual

locations for well pads as practical, use pipeline corridors were practical, locate collector pipelines underneath or alongside access roads, reduce stripping of entire pipeline width); address topsoil removal, storage, and handling criteria; describe runoff, erosion, and sedimentation control procedures; entail seedbed preparation, seed mix, and seeding application procedures; require noxious weed identification and control; describe productivity enhancement measures such as fencing, mulching, fertilization; and describe the location of production facilities to maximize the area for interim reclamation.

An additional purpose of the on-site inspection is to identify sites that may need to be avoided or identified as problem areas for reclamation. Avoidance and areas of low reclamation potential include areas with high erosion potential, soils with a high alkaline and salt content, areas with saturated soils such as seeps, wetland and riparian areas (e.g., perennial stream channels and open water areas) and buffer zones, and ephemeral and intermittent channels.

If the areas cannot be avoided, the operator would be required to modify the reclamation section of the surface use plan of the APD to address and demonstrate that these problem areas could meet reclamation objectives. If reclamation is not achievable and would result in unnecessary and undue degradation and is documented in a site-specific EA, the proposed surface disturbance could be denied.

Topsoil is stockpiled from at all proposed disturbance areas unless the BLM deems that leaving topsoil in place (e.g., during pipeline construction) would better facilitate successful reclamation. Prior to BLM authorization of surface disturbance, the amount of topsoil or other suitable plant growth material to be removed and topsoil storage areas would be specified. If less than six inches of topsoil are available, topsoil may be mixed with suitable subsoil materials for stockpiling so that a minimum of six inches of plant growth material is available for use during reclamation. Whenever possible, topsoil would be used immediately during interim reclamation. Topsoil stockpiled for more than one growing season would be protected from erosion by seeding and reducing piles to less than four feet in height.

Whenever possible, sites are designed to balance cuts and fills to minimize the volume of subsoil stockpiled. When subsoil materials are stockpiled, they are isolated from topsoil stockpiles, and located so as not to affect existing drainages. These stockpiles are kept as small as possible and constructed to remain stable until they are used during reclamation. In addition, they would be located to minimize construction activity during recontouring of the site.

In most instances, vegetation surrounding the proposed sites provides sufficient information to determine reclamation seed mixes. The success of revegetation with existing seed mixes on nearby disturbed sites will be evaluated and modified if needed to ensure revegetation objectives are met. The evaluation will include the determination of the most adaptive species to address severe problems of erosion and weed invasion. Native species are preferred, though certain non-native species could be selected if necessary to meet critical on-site reclamation objectives when native species are unavailable.

Soil testing could be required in areas with poor soils (e.g., high salinity, alkalinity, low productivity) and/or on disturbed sites that have failed to meet revegetation objectives. Soil testing and reporting would be the responsibility of the operators. Testing may include, but is not necessarily limited to pH, texture; salinity; alkalinity, nitrogen, phosphorous, and potassium levels; organic matter, and toxic elements (e.g., selenium).

Prior to construction, proposed pad and facility site locations are surveyed and staked and the

BLM reviews all erosion control design considerations. Wellpads are designed and constructed to disturb the smallest area necessary while still taking into account safety and operational needs.

Interim reclamation occurs immediately on all disturbed areas where permanent reclamation measures cannot be initiated due to on-going construction or operational activities at the site. Disturbed areas subject to interim reclamation include road cut-an-fill areas and portions of each wellpad and ancillary facility site not needed for production related activities, or for topsoil and subsoil stockpiles. Interim reclamation objectives include erosion control measures to stabilize disturbed areas, minimization and/or control of surface runoff, early seeding and establishment to provide soil cover to help prevent erosion and control of noxious weeds.

Final reclamation is conducted on locations, or portions of locations, no longer needed for the project. Upon project completion, all disturbed areas except roads to be retained for other land uses would be reclaimed permanently as designated by the BLM or surface owner.

Summary Evaluation of Reclamation

Oil and gas development began in this Resource Area in the late 1950s. The procedures for planning, constructing, drilling and producing, and reclaiming a site have evolved with the development of new laws, regulations, and policies over the past 40 years. In GSRA, the reclamation policy has evolved from the 1984 RMP and 1991 FEIS and Plan Amendment along with experience gained through on-going development.

In 1997, BLM evaluated the majority of producing wells in the Resource Area for consistency to the new GSRA reclamation policy and to provide data for this SEIS. Sixty-nine of 75 producing wells drilled from 1957 to 1995 were evaluated and summarized in Table 1-1. The main components of this table document for each well the amount of acres disturbed, the amount acres in use, and the degree of reclamation in progress for each well. The monitoring methods described in the GSRA reclamation policy were used. This method was adopted to provide a minimum level of measurement along with professional judgement given time and manpower constraints to evaluate the number of wells. The different components of the section in Table 1-1 labelled "Reclamation in Progress" are used to assess progress toward meeting the final objective. The evaluation was conducted from May through November of 1997. Due to this time frame, some of the conditions measured could have changed to the positive and or negative at each site due to time of season and climatic conditions. In addition, the use of the well for re-completion activities, the addition or removal of production facilities, and/or the addition of another well bore, could affect the amount of surface disturbance and the amount of reclamation in progress. Also, this evaluation measured all the wells for the objectives stated in the 1997 GSRA reclamation policy, which were not required in past permits. Table I-1 is separated into 4 time periods to reflect the evolution of reclamation due to laws, regulations, BLM resource management plans and policies.

1955 to 1976

"The BLM authority to require reclamation has only existed since the passage of the Federal Land Policy Management Act of 1976. Wells abandoned prior to that time were reclaimed haphazardly at best and primarily as gratis by the companies involved." In majority of cases "natural reclamation" has stabilized and re-vegetated the site. An attempt to further reclaim the location at this time would do more harm than good" (FEIS, A-3). This was the situation and policy in 1991 and remains in place at this time.

There are 16 sites that were constructed, drilled and plugged and abandoned in Region 4 prior to 1976. These sites have not been monitored or inventoried for reclamation status. These sites have self re-vegetated and some are continually used for camping sites for hunting. None of these sites are known to have critical problems of erosion or weeds. If these problems are identified, especially noxious weeds, BLM would take immediate action.

Prior to 1976, there were 8 sites drilled and currently producing natural gas. Four of these sites were measured and shown in Table I-1. The average amount of surface disturbed area is 2.2 acres, the amount still in use is .8 acres (36%), and the average amount of area under reclamation is 1.4 acres (64%). Of the average amount of reclamation in progress (1.4 acres), 36% is operator complete, 50% is acceptable, 0 is at risk, and 14 % is unacceptable.

It is important to note that wells listed on the table are prc-1976 wells and the authorizations did not provide reclamation requirements and/or objectives. Critical problems such as noxious weeds & severe erosion are addressed whenever they are identified. Reasonable actions to accomplish the 1997 Reclamation Policy will be required of the operators. Some actions such as re-contouring may not be reasonable due to construction practices at the time and/or existing natural re-vegetation may be successful and offset the need to re-disturb a site. These well sites will go through a case-by-case review and determination of remedial actions.

1977 to 1988

There are 22 producing gas wells. 18 of those wells were measured and are shown in Table 1-1. The average amount of surface disturbed area is 3.2 acres, the amount still in use is 2.5 acres (78 percent), and the average amount of area under reclamation is .7 acres (22 percent). Of the average amount of reclamation in progress (.7 acres), 43% is operator complete, 17% is acceptable, .8% is at risk, and 43% is unacceptable.

Standard reclamation measures such as seeding and erosion control were incorporated but reclamation was usually presented as a end product rather than a process. There was little recognition to pre-planning and interim reclamation processes. Monitoring was conducted on construction and on clean-up and reclamation after the well was completed and facilities installed. Evaluation and monitoring activities of reclamation (re-vegetation and erosion control) were accomplished using subjective review without clear reclamation objectives. Evaluation of reclamation was conducted with an overall objective of site stabilization for erosion control and a vegetative cover without noxious weeds. Table I-1. The average amount of surface disturbed area is 3.2 acres,

1989 to 1995

There are 47 producing gas wells and all 47 were measured and are shown in Table I-1. The average amount of surface disturbed is 3.0 acres, the amount still in use is 1.6 acres (53 percent), and the average amount of area under reclamation is 1.4 acres (47 percent). Of the amount of reclamation in progress, 21percent (.3 acre) is operator complete, 24 percent is acceptable, 49 percent is at risk, and six percent is unacceptable.

In 1989 oil and gas development began to increase and GSRA initiated the FEIS. The increased activity along with writing the EIS resulted in reviewing reclamation practices in GSRA. The FEIS did present standard mitigating measures for construction and reclamation actives to be used for well pad, road, and pipelines.

These measure are identified as Conditions of Approval in Appendix D of the FEIS. These COAS have been modified and added to as

needed for each APD and/or pipeline depending on site-specific conditions and resources.

Attention was now being placed on reclamation planning, methodology, and monitoring. The focus of an APD authorization was to reduce surface disturbance and to implement interim reclamation measures. The majority of APDs received in this time frame were modified fro the on-site exam by moving the road and/or well pad to prevent and mitigate impacts. Reclamation measures increased such as the use of re-contouring, deep ripping, fencing of reclaimed areas, immediate seeding of disturbed areas during construction and after reshaping, seeding topsoil piles etc.

1995 to 1997

There are 40 wells in this category that were within the first two growing seasons after the well had been completed. Only 13 have been measured to date. The average amount of surface area disturbed is 2.5 acres per well pad, and the amount still in use is 1.1 acres, and the average amount of area under reclamation is 1.4 acres. Emphasis was placed on minimizing the amount of disturbance, erosion control, and re-vegetation.

NOSR Production Area

The Department of Energy's protection program has resulted in the drilling and production of gas wells on the former Naval Oil Shale Reserve #3 since 1984. There are 25 surface locations of which one has been plugged and abandoned (2-W-26), and there are 5 dual locations for a total of 30 well bores since 1984. These wells were not reclaimed to GSRA reclamation standards at the time or specifically to the 1997 GSRA reclamation policy. The wells have been evaluated for conformance to the 1997 policy since BLM will require that the well sites meet the 1997 policy objectives.

The total disturbance for 30 well bores is 87.6 acres is 2.9 acres per well bore or 3.5 acres per location. The amount still in use is 58.1 acres or 2.3 acres per location. The amount of acres under reclamation is 32.45 or 1.3 acres per location. Of the amount of reclamation in progress, zero percent is operator complete, six percent (2 acres) is acceptable, 31 percent (9.9 acres)is at risk, and 63 percent is unacceptable.

Overall Summary

As described earlier, reclamation as a "process" has been under constant modification since 1989. The modifications reflected many changes in direction due to lack of Resource Area objectives for reclamation. Evaluations of reclamation were subjective without the objectives. The 1997 GSRA reclamation Policy established objectives and procedures for reclamation and monitoring.

Most of the producing gas wells (1957 to 1997) were reviewed for conformance with the new policy and the data is shown in Table I-1. This table will be used as a management tool to establish cumulative baseline data of acreage disturbed and acreage under reclamation. The table also helps identify site specific deficiencies and information to help evaluate the effectiveness of the reclamation policy and methodology.

An overall assessment of this table shows the following:

- The overall amount of acreage disturbed for each well is 3.0. This differs slightly from the amount of 3.4 acres used in this document for identification of existing and future impacts. The 3.4 figure was generated by computer in the early stages of this document. The discrepancy is considered very minor and both figures are considered usable and relevant.
- The average amount of acres in use for the well pad is .45 and 1.2 for the road.
- The average amount acres under reclamation per well is 1.4. Of this amount the average

amount that is unacceptable is 6percent, at risk is 48percent, acceptable is 24percent, and operator complete is 21percent (Table I-1, data group of 1989 to 1995).

- The amount acreage disturbed per well decreased slightly to 2.5 in 1996 and to 2.8 in 1997.

Conclusions

1. Overall, the reclamation policy and procedures are effective. The majority of sites stabilized and re-vegetating and problem areas are being re-treated.

2. The most effective measures for well pads are: proper siting of the well pad to minimize impacts, the immediate seeding of disturbed areas after construction, proper storage and re-distribution of topsoil, interim reclamation of re-shaping and seeding within the first available growing season after disturbance, deep ripping, re-shaping cut and fill slopes to a minimum of 3:1, fencing of seeded areas to protect from livestock use for the initial two years of growth, and the use of rip-rap and slash to help control sediment loss.

3. Addressing the reclamation potential of individual sites and identifying methods to achieve the reclamation objectives during the on-site exam and in the APD is essential in achieving the objectives.

4. There are some needed improvements in the data gathered and methods to reflect changes in well pad uses. For instance, percent of natural slope and re-shaped slopes should be measured. The amount of acres in use and the amount of acres under reclamation are subject to changes given reclamation re-treatments and various needs of the well pad for activities such as re-completions, workovers, and facility modifications. Also, differences may need to noted in the "at risk" column to differentiate problems with erosion control versus re-vegetation.

Definition of Reclamation Categories

Monitor--Unacceptable. These areas have critical problems such as noxious weeds, erosion problems (rills in excess of 3 inches), and/or demonstrate no potential to meet reclamation objectives(i.e., a seeding failure). Treatment and frequent monitoring as often as once a month.

Monitor--At Risk: These areas are in transition and require frequent monitoring, typically, 1-3 times a year to assure progress. They are acceptable in a sense that some objectives have been met but they have not proved sustainability. For instance, a disturbed area that has been seeded and has less than two growing seasons would be labelled "at risk" to assure the vegetation has the potential of self perpetuation. Areas that have been re-disturbed and re-treated would also fall in this category. Treatment could be required as determined to meet reclamation objectives.

Acceptable: These areas have met most of the objectives and probably need no further treatment although time is needed to fulfill the objectives. For example, the shrub component of re-vegetated cover is only 1 or 2 percent covers opposed to the objective of 5percent. Periodic monitoring would continue.

Operator Reclamation Complete: The Operator has successfully completed the required reclamation practices. The reclamation objectives have been achieved for two consecutive years. The operator has completed his reclamation responsibilities. Periodic monitoring of these sites will continue until they are plugged and abandoned by the operator.

Table I-2-1. BLM Gas Well Surface Disturbance and Reclamation Status

	Well Number	Completion Date MM/DD/YY	Acres Disturbed				Acres in Use		Reclamation in Progress			Operator Reclamation Complete
			Total	Road		Pad	Road	Pad	Monitor (Unaccept)	Monitor (At Risk)	Acceptable	
				Acres	Miles							
Producing Wells: 1957 to 1976 (Pre-FLPMA)												
1	Juhan 1	06/28/57	2.0	0.3	0.1	1.7	0.3	0.3	0.7	0.0	0.5	0.2
2	29-95	08/21/61										
3	14-95	04/26/62	2.4	0.5	0.3	1.9	0.5	0.2	0.0	0.	1.7	0.0
4	30.95	10/24/62	Not measured									
5	28-95	12/11/62	Not measured									
6	29-95A	02/02/66										
7	3-94	02/12/65	2.9	1.0	0.3	1.9	1.0	0.3	0.0	0.0	0.7	0.6
8	35-94	04/04/72	1.7	0.0	0.0	1.7	0.0	0.4				1.3
Subtotal			**9.0**	**1.8**	**0.7**	**7.2**	**1.8**	**1.2**	**0.7**	**0.0**	**2.9**	**2.1**
Producing Wells: 1977 to 1988												
9	122 (Dual to #8)	09/02/80	3.1	1.0	0.4	2.1	0.9	1.1	0.0	0.0	1.1	0.0
10	118	09/10/80	1.7	0.3	0.1	1.4	0.3	0.5	0.3	0.3	0.3	0.0
11	26-3	10/01/80										
12	8 (Dual to 122)	10/01/80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	3-28	05/30/81	Not measured									
14	2-20	07/31/81	Not measured									
15	H-25	01/27/82	Not measured									
16	D-31	02/05/82	Not measured									
17	14-24 (Dual to 14-24A)	12/15/82	3.16	0.06	0.04	3.1	0.06	1.1	1.0	0.0	1.0	0.0
18	14-24A (Dual)	01/16/83	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	161	04/16/84	1.6	0.2	0.2	1.4	0.2	0.4	0.7	0.3	0.0	0.0
20	14-12	11/30/84	1.6	0.2	0.2	1.4	0.2	0.7	0.2	0.0	0.5	0.0
21	30-11	01/14/85	Not measured									
22	1(4-3)	06/22/85	10.1	8.4	2.0	1.7	8.4	0.7	0.2	0.2	0.0	0.8
23	5-10	04/10/86	11.7	9.6	4.9	2.1	9.6	0.4	0.5	0.0	0.0	1.2
24	MV 11-11	12/22/86	2.0	0.6	0.4	1.4	0.6	0.3	0.3	0.0	0.0	0.9
25	W-37-1	05/08/87	1.8	0.9	0.3	0.9	0.9	0.3	0.4	0.2	0.0	0.0
26	W-34-2	08/28/87	3.0	2.0	1.0	1.0	2.0	0.3	0.3	0.0	0.4	0.0
27	MV16-9	11/04/87	9.0	7.0	2.0	2.0	9.0	0.4	0.5	0.2	0.0	0.9
28	MV12-3	11/20/87	3.1	1.6	0.8	1.5	1.6	0.5	Spot 0.01	0.1		0.9
29	MV 15-8C	09/28/88	4.1	1.8	0.5	2.3	1.8	0.8	0.1	0.1	0.3	1.0

	Well Number	Completion Date MM/DD/YY	Acres Disturbed				Acres in Use		Reclamation in Progress			Operator Reclamation Complete
			Total	Road		Pad	Road	Pad	Monitor (Unaccept)	Monitor (At Risk)	Acceptable	
				Acres	Miles							
30	27-11	10/18/88	1.8	0.7	0.2	1.1	0.7	0.0	1.1	0.0	0.0	0.0
31	10-23	12/09/88	3.3	2.0	0.9	1.3	0.9	0.7	Spot 0.01	0.1	0.0	0.3
Subtotal			**56.94**	**36.6**	**13.94**	**24.7**	**37.16**	**8.2**	**5.32**	**1.2**	**2.2**	**5.2**
Producing Wells: 1989 to 1995												
1	W-24-29	10/05/89	2.1	0.5	0.2	1.6	0.5	0.2	0.0	0.2	0.0	1.4
2	MV 8-4	01/11/90	5.4	3.8	0.7	1.6	3.8	0.5	0.2	0.7	0.2	0.0
3	MV 7-4M	01/14/90	1.6	0.3	0.1	1.3	0.3	0.3	0.0	0.5	0.5	0.0
4	17-32MV	09/04/90	2.3	0.9	0.4	1.4	0.9	0.7	0.0	0.2	0.5	0.0
5	9-17W (Dual to 9-17MV)	12/31/90	2.5	0.0	0.0	2.5	0.0	0.5	0.0	1.8	0.0	0.0
6	9-17MV (dual)	12/31/90	0.2	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0
7	GV 8-14C	01/31/91	2.1	0.7	0.2	1.4	0.7	0.7	0.0	0.3	0.4	0.0
8	K-2-7-94S	06/07/91	1.9	0.3	0.1	1.6	0.3	0.6	0.0	0.9	0.1	0.0
9	D-16-7-94M	06/14/91	2.9	1.2	0.3	1.7	0.3	0.6	0.2	0.1	0.6	0.3
10	J-1-7-94M	06/23/91	1.4	0.0	0.0	1.4	0.0	0.7	0.2	0.3	0.2	0.0
11	O-4-7-94	07/17/91	2.4	0.7	0.2	1.7	0.6	0.5	0.3	0.4	0.3	0.3
12	J-10-7-94	09/15/91	1.9	0.0	0.0	1.9	0.0	0.6	0.1	0.5	0.7	0.0
13	MV 34-5	01/03/91	2.5	0.3	0.1	2.2	0.6	0.3	0.0	0.0	0.2	1.7
14	MV 18-32	11/26/91	5.7	4.0	0.7	1.7	4.0	0.9	0.2	0.1	0.2	0.3
15	MV 45-10	08/06/93	2.4	0.3	0.1	2.1	0.3	0.5	0.2	0.2	0.4	0.8
16	GR 21-3V	08/21/93	1.9	0.1	0.1	1.8	0.1	0.3	0	0.1	0.2	1.2
17	GR 43-3V	08/26/93	2.3	0.0	0.0	2.3	0.0	0.6	0.0	0.8	0.5	0.4
18	MV 32-4	09/15/93	2.5	1.0	0.3	1.5	1.0	0.4	0.1	0.0	0.3	0.7
19	MV 50-9	10/26/93	4.8	2.4	0.5	2.4	0.5	0.3	0	0.0	0.2	3.8
20	GR 23-11V	11/22/93	6.1	4.6	0.9	1.5	4.6	0.4	0	0.1	0.4	0.6
21	MV 46-21	01/07/94	1.8	0.1	0.0	1.7	0.1	0.6	0.2	0.4	0.5	0.0
22	MV 61-8 (Dual 60-8D)	04/07/94	2.4	0.7	0.2	1.7	0.7	0.5	0.0	0.03	0.9	1.2
23	MV 60-8D (Dual to 61-8)	04/20/94	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	GR 24-32	05/14/94	2.7	1.0	0.3	1.7	1.0	0.3	0.0	0.2	1.2	0.0
25	GR 24-35	05/27/94	2.5	0.8	0.2	1.7	0.8	0.4	0.2	0.0	1.1	0.0
26	GR 32-34	05/28/94	2.3	0.8	0.2	1.5	0.8	0.4	0.2	0.2	0.4	0.3
27	GR 21-4	06/21/94	2.7	0.5	0.1	2.2	0.5	0.3	0.3	1.6	0.0	0.0
28	1-M-35	08/01/94	4.8	3.0	0.6	1.8	3.0	0.3	0	0.0	0.2	1.3
29	MV 39-3	09/07/94	3.4	1.9	0.4	1.5	1.9	0.4	0.0	0.2	0.7	0.5

	Well Number	Completion Date MM/DD/YY	Acres Disturbed				Acres in Use		Reclamation in Progress			Operator Reclamation Complete
			Total	Road		Pad	Road	Pad	Monitor (Unaccept)	Monitor (At Risk)	Acceptable	
				Acres	Miles							
30	MV28-4	09/29/94	2.3	0.3	0.1	2.0	0.3	0.2	0.1	1.1	0.3	0.3
31	30-16	10/19/94	3.5	0.5	0.1	3.0	0.5	0.6	0.0	0.7	1.5	0.2
32	MV 58-19	10/28/94	4.5	2.5	0.6	2.0	2.5	0.4	0.0	1.4	0.0	0.0
33	GR 12-29	10/31/94	1.9	0.0	0.0	1.9	0.0	0.4	0.0	1.1	0.0	0.0
34	MV 59-30	10/31/94	5.2	3.6	0.7	1.6	3.6	0.6	0.4	0.6	0.0	0.0
35	1-13	11/12/94	4.1	2.1	0.6	2.0	0.6	0.4	0.0	1.5	0.1	0.0
36	RMV 6-20	12/01/94	2.7	0.6	0.1	2.1	0.6	0.6	0.4	1.1	0.0	0.0
37	2-15	12/05/94	5.2	3.2	0.8	2.0	3.2	0.7	0.1	0.8	0.4	0.0
38	RMV 15-35	12/12/94	1.8	0.0	0.0	1.8	0.0	0.4	0.0	1.3	0.1	0.0
39	RMV 16-35	12/20/94	1.0	1.1	0.3	1.1	1.1	0.4	0.3	0.6	0.1	0.0
40	SAV 1-3	01/29/95	6.2	4.3	0.8	1.9	4.3	0.6	0.5	0.5	0.3	0.0
41	2-M-35 DGAL	GR13-35	3.2	1.7	0.6	1.7	1.7	0.6	0.1	0.8	0.0	0.0
42	GR 1-3SH	10/30/95	2.8	1.0	0.3	1.8	1.0	0.5	0.2	1.1	0.0	0.0
43	13-28	11/29/95	5.9	2.2	0.4	3.7	2.2	0.6	0.3	2.8	0.0	0.0
44	RMV 58-20	12/06/95	1.6	0.1	0.0	1.8	0.1	0.3	0.0	1.2	0.0	0.0
45	RMV 33-20	12/15/95	2.0	0.1	0.0	1.9	0.1	0.4	0.0	1.5	0.0	0.0
Subtotal			**131.4**	**53.2**	**12.5**	**79.7**	**50.8**	**20.7**	**4.3**	**28.4**	**13.7**	**15.3**
Producing Wells: 1995 to 1997												
46	RMV 59-17	01/09/96	0.1	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0
47	RMV 40-20	06/11/96	2.0	0.1	0.0	1.9	0.1	0.5	0.0	1.4	0.0	0.0
48	12-33-6-92	06/12/96	5.0	1.3	0.4	2.7	1.3	0.8	.06	1.9	0.0	0.0
49	Snyder 18-10	06/21/96	3.4	0.8	0.2	2.6	0.8	0.5	0.0	2.1	0.0	0.0
50	14-28-6-92	08/09/96	4.6	2.3	0.7	2.3	2.3	0.7	.06	1.6	0.0	0.0.
51	Vessels 13-33	09/26/96	3.2	0.6	0.3	2.6	0.6	0.8	0.0	1.8	0.0	0.0
52	Vessels 15-29	10/15/96	2.8	0.1	0.0	2.7	0.1	1.0	0.3	1.4	0.0	0.0
53	RMV 63-19	11/27/96	3.6	2.2	0.7	1.4	2.2	0.3	.06	1.1	0.0	0.0
54	HMU 5-16	12/28/96	1.6	0.0	.0	1.6	0.0	0.5	0.0	3.0	0.8	0.0
55	RU 34-6	12/23/96	4.6	0.4	0.2	4.2	0.4	1.4	0.0	2.8	0.0	0.0
56	GR 13-35 (dual 2M35)	02/07/97	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
57	RMV 200-20	07/08/97	1.3	0.0	0.0	1.3	0.0	0.3	0.0	1.0	0.0	0.0
58	GM 201-4	07/17/97	2.4	0.7	1.5	1.7	Not measured					

	Well Number	Completion Date MM/DD/YY	Acres Disturbed				Acres in Use		Reclamation in Progress			Operator Reclamation Complete
			Total	Road		Pad	Road	Pad	Monitor (Unaccept)	Monitor (At Risk)	Acceptable	
				Acres	Miles							
59	RMV 201-20 (Dual RMV 95-20)	08/07/97	0.3	0.0	0.0	0.3	0.0	0.0	0.0	0.3	0.0	0.0
60	GR 42-4	09/23/97	2.4	0.7	0.2	1.7	Not measured					
61	Redpoint 44-36	10/03/97	1.8	0.2	.05	1.6	Not measured					
62	GM 22-3	10/03/97	3.0	1.0	.25	2.0	Not measured					
63	RU 14-6	10/10/97	1.5	0.0	0.0	1.5	Not measured					
64	Fusilier 2-11	07/97	2.4	0.4	0.1	2.0	Not measured					
65	MV 102-3	07/97	2.7	0.1	0.02	2.6	Not measured					
66	1-22	09/12/97	1.5	0.0	0.0	1.5	Not measured					
67	1-42	09/12/97	2.3	0.4	0.1	1.9	Not measured					
68	Vessels 12-28	11/14/97	4.0	2.0	.47	2.0	Not measured					
69	GM 33-3	12/17/97	4.0	2.0	.47	2.0	Not measured					
70	GM 34-3	12/17/97	1.8	0.0	0.0	1.8	Not measured					
71	GM 44-3	12/23/97	2.7	1.0	.26	1.7	Not measured					
72	SAV 1-32	10/23/97	1.8	0.2	.05	1.6	Not measured					
73	SAV 1-31	11/13/97	3.8	2.1	0.5	1.7	Not measured					
74	SAV 2-22	11/25/97	1.8	0.2	.05	1.6	Not measured					
75	1-21	01/06/98	3.2	1.2	.28	2.0	Not measured					
76	SAV 2-21	01/6/98	3.4	1.4	.34	2.0	Not measured					
77	SAV 2-31	12/31/97	2.7	0.8	0.2	1.9	Not measured					
78	Huggard 2-12	01/13/98	1.7	0.0	0.0	1.7	Not measured					
79	GM 12-33	12/04/97	6.0	4.0	0.9	2.0	Not measured					
80	GM 13-33	12/16/97	3.5	1.9	.28	1.6	Not measured					
81	GM 24-33 (36-33)	12/16/97	3.0	1.5	.28	1.5	Not measured					
82	RMV 56-21		1.9	0.3	0.1	1.6	Not measured					
83	Scarber 2-42		2.1	0.3	0.1	1.8	Not measured					
84	GM 201-4		2.4	0.7	1.5	1.7	Not measured					
Subtotal			**99.3**	**30.3**	**31.32**	**68.9**	**7.8**	**6.9**	**.48**	**18.4**	**0.8**	**0.0**
Grand Total			**296.64**	**121.90**	**58.46**	**180.5**	**99.0**	**37.0**	**10.80**	**48.00**	**19.60**	**22.60**

Table I-2-2. DOE Gas Well Surface Disturbance and Reclamation Status

	Well Number	Completion Date MM/DD/YY	Acres Disturbed				Acres in Use		Reclamation in Progress			Operator Reclamation Complete
			Total	Road		Pad	Road	Pad	Monitor (Unaccept)	Monitor (At Risk)	Acceptable	
				Acres	Miles							
1	1-M-9 (dual 1-W-9)	11/06/84 07/30/90	2.7	0.6	0.2	2.1	0.6	1.0	0.9	0.2	0.0	0.0
2	1-M-19 (dual 1-W-19)	11/01/85 07/24/90	2.6	0.5	0.2	2.1	0.5	0.7	0.6	0.8	0.0	0.0
3	1-W-32	08/03/89	1.3	0.4	0.1	1.9	0.4	0.5	0.0	0.2	0.4	0.0
4	1-W-29	08/09/89	2.8	0.5	.15	1.1	0.5	0.7	0.0	0.2	0.2	0.0
5	1-M-29	06/25/93	--	--	--	1.2	--	0.8	0.4	0.0	0.0	0.0
6	2-W-26 P&A	08/10/93	2.0	1.1	0.3	0.9	1.1	0.0	0.0	0.9	0.0	0.0
7	2-W-29	08/16/89	2.2	0.7	0.2	1.5	0.7	0.4	0.2	0.4	0.6	0.0
8	1-W-21	08/23/89	0.7	0.0	0.0	0.7	0.0	0.5	.05	1.5	0.0	0.0
9	1-W-28	08/31/89	3.1	1.8	0.6	1.3	1.8	1.0	0.0	0.3	0.0	0.0
10	1-W-26	09/07/89	4.0	3.4	0.8	0.6	3.4	0.3	0.0	0.1	0.2	0.0
11	2-W-27	09/14/89	3.9	2.9	0.8	1.0	2.9	0.4	0.0	0.0	0.6	0.0
12	1-W-27	09/28/89	6.5	5.0	1.2	1.5	5.0	0.4	0.0	1.1	0.0	0.0
13	3-W-29 (dual 2-M-29)	09/29/91 12/13/93	4.7	2.7	0.8	2.0	2.7	0.7	0.0	1.3	0.0	0.0
14	2-W-21	10/01/91	1.7	0.2	.06	1.5	0.2	0.3	0.6	0.6	0.0	0.0
15	1-W-20 (dual PW3-20	10/04/91 08/27/95	5.6	4.0	1.2	1.6	4.0	0.7	0.7	0.2	0.0	0.0
16*	1-M-36	07/25/93	2.2	1.0	0.3	1.2	1.0	0.5	0.7	0.0	0.0	0.0
17	2-W-20 as of 10/97	07/30/93	0.0	0.0	1.7	0.0	0.0	0.7	1.0	0.0	0.0	0.0
18	1-M-31	01/09/94	5.2	3.2	1.0	2.0	3.2	0.3	1.7	0.0	0.0	0.0
19	2-M-36	08/11/94	8.2	3.4	0.8	4.8	3.4	1.0	4.4	0.0	0.0	0.0
20	1-M-8 (dual 1-M-18ST	09/19/94 11/08/94	3.7	1.8	.55	1.9	1.8	0.4	1.5	0.0	0.0	0.0
21	3-W-21 as of 10/97	11/11/94	3.7	1.3	0.3	2.4	1.3	0.3	1.7	0.4	0.0	0.0
22	RM 2-8	08/01/95	3.4	0.8	.25	2.6	0.8	0.7	0.9	0.0	0.0	0.0
23	PM 2-31	09/10/95	7.9	4.7	1.3	3.2	4.7	0.5	2.7	0.0	0.0	0.0
24	1-M-25		6.7	3.8	0.9	2.9	3.8	0.6	1.5	0.8	0.0	0.0
25	MV 37-32		2.8	0.4	0.1	2.3	0.4	0.5	1.0	0.9	0.0	0.0
Total			**87.6**	**44.2**	**13.81**	**44.3**	**44.2**	**13.9**	**20.55**	**9.9**	**2.0**	**0.0**

* Serious road problem

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Glenwood Springs Resource Area
50629 Highway 6 and 24
P.O. Box 1009
Glenwood Springs, Colorado 81602

IN REPLY REFER TO:

July 18, 1997

To: All Employees

From: Area Manager

Re: Reclamation Goals and Objectives for Oil and Gas operations on the Glenwood Springs Resource Area (GSRA)

As the intensity and extent of natural gas development in the GSRA increases, the interest in and discussion of reclamation standards has also increased. The purpose of this memorandum is to document the GSRA's reclamation goals and objectives for oil and gas development and to clarify expectations of our operators relative to reclamation success.

While this memo establishes specific reclamation standards for oil and gas operations, each program leader is responsible for developing reasonable reclamation goals for all surface disturbing activities. These objectives may be applied to other activities as appropriate.

Reclamation goal.

The reclamation goal is to control erosion on the site and establish desirable (seeded and native) vegetation to set the stage for natural processes to restore the site. The oil and gas operator will implement any/all reasonable and prudent practices necessary to achieve the reclamation goal.

Reclamation objectives.

Erosion on a site will be considered controlled when water naturally infiltrates into the soil; gullying, headcutting or slumping is not observed; rills are less than 3 inches deep; and deeper or excessive rilling is not observed. The site will be photographed to document the presence or absence of gullies, headcuts, slumps or rills and observations noted.

Desirable vegetation on a site will be considered established when:

1. No noxious weeds are present. Noxious weeds are listed on the county and state noxious weed lists. All noxious weeds will be treated. On a case-by-case basis, it may be necessary to treat adjacent lands in order to prevent the spread of noxious weeds onto reclaimed sites.

2. Undesirable vegetation comprises little (less than 5%) of the species composition on sites

with 3 or more growing seasons. On sites with one or two growing seasons post treatment, some undesirable vegetation is expected, but it will be considered a problem only when there is no emergence of the planted species. For this objective, desirable vegetation is native species or species included in the seed mix.

3. Desirable vegetation appears vigorous and self sustaining. The plants have the opportunity to complete their annual life cycles. This objective will be evaluated by observing the size, color and vigor of the plants, and noting the presence of new growth shoots, flowers, seeds, litter build-up, and seedlings.

4. Adequate diverse vegetation is present. The site appears to be fully occupied with primarily desirable vegetation and contains a mixture of grasses, forbs, and shrubs. Ideally, a good grass cover with an estimated 10% forbs and 5 to 10% shrubs would be present and the canopy cover of the reclaimed site should be equal to or greater than similar sites on the adjacent undisturbed area.

The Reclamation Timeline.

A site goes through four distinct stages from initial disturbance to restoration. A site can be in more than one stage of reclamation. For example, most of a site could be in the "operator reclamation in progress" category while the production area could be in the "area in use" category. The stages of reclamation are:

1. Area in Use - At first this is the entire site. After drilling is complete and the site is in production, this area includes the road surface, production facilities, and the associated vehicle access areas.

2. Operator Reclamation in Progress - It is the intent of this policy that the operator implement reclamation practices as soon as possible after disturbance and every year thereafter as necessary to achieve the reclamation objectives. Most of the sites on the GSRA are in this category. These sites range from recently contoured and seeded, to almost reclaimed. These sites are where most of the reclamation work is being done. These sites are also the priority for monitoring.

This category is split into the "monitor" and "acceptable" sub-groups. When most of the reclamation objectives are not being met the site is in the "monitor" group. When most of the reclamation objectives are being met the site is in the "acceptable" group.

The sites in the "Operator Reclamation in Progress" category plus the "Area in Use" category equal the total "unreclaimed" acres.

3. Operator Reclamation Complete - Operator has successfully completed the required reclamation practices. The reclamation objectives have been achieved for two consecutive years. The operator has completed his reclamation responsibilities. Periodic monitoring of these sites will continue until they are abandoned by the operator. The western GSRA sites

would likely be in this category for many years, depending on the weather and the site's potential.

The sites in the "Operator Reclamation Complete" category plus the sites in the "Operator Reclamation in Progress" and the "Area in Use" categories equal the total acreage presently modified by oil and gas activity.

4. Restored - Successional processes no longer associated with oil and gas development are the dominate site modifiers, and the site is no longer distinctly different from the surrounding area. In the harsh and arid environment of the western portion of the resource area, and because perennial species were planted as a reclamation practice, it is likely that sites would not be considered restored any sooner than 20 years after disturbance.

Monitoring methods.

To evaluate achievement of the objectives and determine the stage of reclamation, canopy cover by species will be measured or estimated and a 3 foot x 3 foot grid will be photographed at representative locations on the site and adjacent undisturbed areas. The site will be diagrammed. A site form will be filled out. BLM will monitor reclamation status as necessary to ensure operator compliance with the APD, but the operator will also have new responsibilities for monitoring and reporting reclamation success (see below).

Evaluation of current reclamation.

The results of the monitoring will determine whether and to what degree the objectives are being achieved and thus form the basis for necessary follow up actions, such as re-treatments, determination of the reclamation categories, and releasing the operator's bond. This monitoring information should also be considered when developing reclamation plans for future APDs.

Operator reporting.

Each operator shall report annually to the BLM the reclamation status of all sites categorized as "operator reclamation in progress." The purpose of this reporting is to document the operator's compliance with reclamation stipulations in the APD, reclamation practices implemented, and the success of those practices. These reports will help BLM set or adjust monitoring priorities and improve its reclamation practices and objectives. The GSRA, operators, and COGCC will collaborate to ensure consistency in reporting and methodology and avoid duplication.

Reclamation considerations in the EA.

The BLM will specifically assess the probability of achieving the reclamation objectives. To do this, we'll compare the site proposed in the APD with comparable sites already constructed. For those sites where reclamation success is anticipated to be more difficult based on previous experiences, BLM will require a site specific reclamation plan be prepared

by the operator. When the proposed site is comparable to sites where reclamation has not been successful, the operator will have to show the current sites can be successfully reclaimed prior to approval of the new APD.

Michael S Motis

Appendix J

PROJECT RULISON

- J-1 BLM Summary Evaluation

- J-2 COGCC Letter

History

On September 10, 1969, a 43-kiloton fission-type nuclear device was detonated at a depth of 8,426 feet in the Williams Fork Formation of the Mesaverde Group. The detonation was part of Project Plowshare, to test and evaluate the feasibility of the use of a nuclear device in a gas productive formation to fracture the rock to increase the production of gas. Project Plowshare was a program of the Atomic Energy Commission (AEC) with Astral Oil Company and was conceived to develop peaceful uses of nuclear technology.

The wellsite is situated in the NE3SW3, Section 25, T. 7 S., R. 95 W. in Garfield County, Colorado, about 32 miles southeast of the community of Battlement Mesa. The project consisted of several phases. Phase I included the drilling of the well (Hayward A #25-95 (R-E)), gas production tests, and necessary geological, hydrological, biological, and environmental studies to ascertain technical and safety considerations, as well as establish a baseline. Phase II was the detonation of the device and recording effects of t+ blast. Phase III, or post blast evaluation consisted of drilling into the blast (Hayward #25-95 (R-EX)) cavity and testing the well to determine cavity volume, fracture length, gas flow rates, and isotopes and levels of radioactivity within the produced gas.

Gas pressure was measured in the R-E well six days after the nuclear blast. The emplacement well was initially planned to be the reentry well. While the gas was not sampled, it was thought that it may contain radionuclides. For this reason the reentry well was directionally drilled from a location 300 feet southeast of the emplacement well.

Drilling of the R-EX well was started in April of 1970. Four production flow tests were carried out during the period between October 1970 and April 1971. The first observed subsurface pressure was 3,156 psi with an initial flow rate of 15,000 MCFGD, but declined to 885 MCFGD with a cavity pressure of 246 psi at the end of 108 days. After a shut in period of 158 days the cavity pressure had only build up to 798 psi. The reentry well only produced 430,243 MCFG during the production testing. The well was then shut in and temporarily abandoned.

The gas was flared or burned at the surface during the production testing phase. Testing was conducted to evaluate the extent and effectiveness of the nuclear stimulation, dimensions and geometry of the cavity and fracture system, evaluate the economic feasibility, radioactivity released, and determine if gas produced from nuclear stimulation could be used for domestic and commercial purposes.

Results

AEC discontinued Project Plowshare after the third experimental detonation, Project Rio Blanco, near Rifle, Colorado. All three of the tests did not achieve the desired results for both formation stimulation and associated economic benefits; nuclear explosive well fracturing was not commercial and public acceptance of the technology was not favorable.

Post detonation cavity size and fracturing was within, or close to the pretest estimates. An overestimation of formation permeability appears to be a major cause of the failure of the expected stimulation results. It also appeared that new unsupported fractures created by the detonation closed soon afterward.

No physical measurements were made of the Rulison cavity. Cavity size and fracture radius were calculated using a computer stimulation program that was based on 622 atmospheric and underground nuclear test detonations at the Nevada Test Site and other locations. Subsurface parameters were obtained from Mesaverde core

samples, open hole electric logs and pre-detonation gas test results. Cavity radius was calculated to be 76 feet, shear fracture length of 276 feet, and the maximum fracture length was predicted to be 433 feet.

A fracture was encountered at a well depth of 8,151 feet in the reentry well. The fracture was identified by a loss circulation, increased drilling penetration rate and the first radionuclides encountered during the drilling. A cavity radius of 78 feet was calculated using Krypton-85 data

Subsequent analysis of well performance conducted by Lawrence Livermore Laboratories yielded a fracture radius of 215 feet. An independent evaluation by DeGolyer and MacNaughton, a reservoir engineering company, resulted in a radius of 220 feet.

Both these analyses agree with the cavity radius of 78 feet calculated using Krypton-85 data and loss of circulation in the reentry well 275 feet above the detonation point.

Cleanup and Restoration

The R-EX, reentry well was shut in during April 1971, and since there were no plans to commercially produce the well, the wells were plugged and abandoned (P&A) and all associated equipment removed. Both wells were plugged after approval by the Colorado Oil and Gas Commission and the U.S. Geological Survey, Division of Oil and Gas, in a manner to permanently isolate formations and prevent migration of water or gas.

Stemming material in the R-E well consisted of sand and gravel and bentonite plugs for ease of reentry. Since the stemming material was determined to be inadequate for permanently plugging the well, the material was removed to a well depth of 5,954 feet. The entire well was then cemented in lieu of leaving a 3,200-foot section filled with plugging mud. The R-EX well was plugged as planned, except that the U.S. Geological Survey required that cement be used in the section between 5,460 and 3,000 instead of plugging mud.

Soil contaminated with diesel fuel and heavy metals (chromium compounds) was removed from the drill rig reserve pit was removed and disposed of in a commercial facility in 1995. No radioactive materials were detected during the pit cleanup.

The surface plant and all equipment were dismantled, decontaminated, released for unrestricted public use, and shipped off site to a location designated by the owner (Astral Oil Company). Material left on site included a power pole with fuse box, telephone line, a concrete slab, and a monument over the reentry well with a description of drilling restrictions. Pits and other excavations were backfilled and the drilling pads reclaimed.

Off-Site Contamination Potential

The Mesaverde Formation was laid down as near-shore deposits, including coastal swamp, floodplain, and marine depositional environments. These type of deposits consists of shale and sandstone, that are discontinuous and lenticular in geometry. The sandstone reservoirs in the Mesaverde represent stream, crevasse splay, tidal channel, and beach deposits. Mesaverde gas wells drilled in the area have porosity in the range of 7 to 8 percent(%), permeability that ranges from .5 to .11 millidarcies, and a water saturation of between 35 to 55 %. These parameters are typical of a tight gas reservoir, that is very fine-grained and contains no free water. The lack of free water was evidenced in the testing of the Rulison wells.

Barrett Resources Corporation submitted an application to COGCC (February 21, 1995) for increased well density that included the Grand

Valley, Parachute, and Rulison areas. The application included geologic and engineering data sufficient to justify well spacing of 40 acres or less.. Outcrop studies and subsurface evaluations demonstrated that the Mesaverde reservoirs are heterogeneous (occur in discrete compartments) and that reservoir modeling indicates that increased well density is necessary to drain

Aquifers in the Rulison area are the alluvial and terrace deposits on and near the surface. The underlying formations including the Green River and Wasatch, formations are for the most part impermeable and do not typically produce water (Reynolds, and others, 1970), while the deeper Mesaverde contains 35 to 55 % water saturation, the water is not mobile (Nork and Fenske, 1970). This was substantiated by the lack or water production during the testing of the Rulison wells.

Potential groundwater contamination are either from subsurface contamination by radionuclides produced by the detonation or from site operations, such as drillback and flaring operations. Earman and others (1996) assessed the potential of transport of radionuclides from the Rulison test site. Their hydrologic modeling and evaluation suggest that the radionuclides are totally contained within the Mesaverde Formation administrated by DOE. Their calculations were based on two key assumptions: 1.) the Mesaverde is water-saturated and 2.) the entire declassified mass of radionuclides resulting from the test migrated out of the blast cavity. Additional studies are recommended if a greater confidence for the model is needed.

Natural gas samples from five producing wells near the Rulison test site were analyzed for radiation by Lawrence Livermore National Laboratory. The wells were sampled during the summer of 1976 by DOE. Radiation analysis of the samples for Tritium, Carbon-14, and Krypton were below detection limit. Analysis of all three combined were low enough to confirm that there was no radioactivity in the gas (Hudson, 1997).

Conclusions

The cleanup operations and subsequent investigations and monitoring of the Rulison site indicate that the potential for contamination of ground water or to the surface is not likely and that any contamination remaining from the test is contained within Lot 11 of Section 25.

STATE OF COLORADO
OIL & GAS
CONSERVATION COMMISSION

DEPARTMENT OF NATURAL RESOURCES
Roy Romer, Governor
1120 Lincoln St., Suite 801
Denver, CO 80203
Phone: (303) 894-2100
FAX: (303) 894-2109
Website: www.dnr.state.co.us/oil-gas

May 5, 1998

Michael S. Mottice
Area Manager
Bureau of Land Management
Glenwood Springs Resource Area
P.O. Box 1009
Glenwood Springs, Colorado 81602

Re: Project Rulison Research Summary and Conclusions

Dear Mr. Mottice,

As you requested, attached is a summary of our research into the Project Rulison nuclear natural gas stimulation experiment for your use in the preparation of the Glenwood Springs Resource Area Supplemental Environmental Impact Statement. Thank you for providing us with the opportunity to provide input into this project.

The research was conducted by the COGCC to ensure that our decisions regarding permitting of natural gas wells in the Battlement Mesa area near Project Rulison would ensure the protection of public health, safety, and welfare.

The following are our conclusions:

1.) The drilling of natural gas wells should not be permitted inside of the "Lot 11" quarter-quarter section of land containing the Project Rulison emplacement well (see the attached annotated well survey plat.) Natural gas well drilling should be permitted outside of that area. This conclusion is based on the extremely low probability of encountering gas with radiation activity due to the limited radius of the chimney cavity and fracture zone created by the nuclear detonation, the limited areal extent of the sandstone lenses within the Williams Fork Formation, and the lack of remaining contaminated gas following the extensive production testing of the re-entry well in 1970 and 1971.

DEPARTMENT OF NATURAL RESOURCES: James S. Lochhead, Executive Director
COGCC COMMISSION: Caroline Blackwell • Allan Heinle • Bruce Johnson • Mike Matheson • Claudia Rebne • Molly Sommerville • Stephen Sonnenberg
COGCC STAFF: Richard T. Griebling, Director • Brian J. Macke, Deputy Director • Morris Bell, Manager of Engineering
Patricia C. Beaver, Manager, Environmental & Commission Affairs• Marnan Peacock, Manager of Information

2.) The COGCC will continue its program of notifying the U.S. Department of Energy Nevada Operations Office when applications for Permits to Drill are received for any well penetrating the Williams Fork formation within a three mile radius of Project Rulison. This will provide the DOE with the opportunity to take gas and fluid samples for radionuclide analysis at these wells during drilling, completion and production operations if they determine that it would to be appropriate to address continuing public concern.

3.) In the extremely remote event that radionuclides are ever detected through sample analysis, the appropriate wells could be ordered shut in by the COGCC and the BLM in their respective jurisdictions, and work could be commenced to more fully assess the situation.

Thank you again for allowing us to provide these comments. Please let me know if we can be of further assistance.

Sincerely,

Brian J. Macke
Deputy Director

cc: Rich Griebling - COGCC
COGCC Commissioners
Sen. Tilman Bishop
Rep. Russell George
Garfield County Commissioners
Peter Sanders - DOE
Steve Moore - BLM
Kermit Weatherbee - BLM
COGA
RMOGA
IPAMS
Battlement Mesa Oil and Gas Committee
Grand Valley Citizens Alliance

APPENDIX J-2: COGCC LETER

Appendix K

FEDERAL OIL AND GAS ROYALTIES

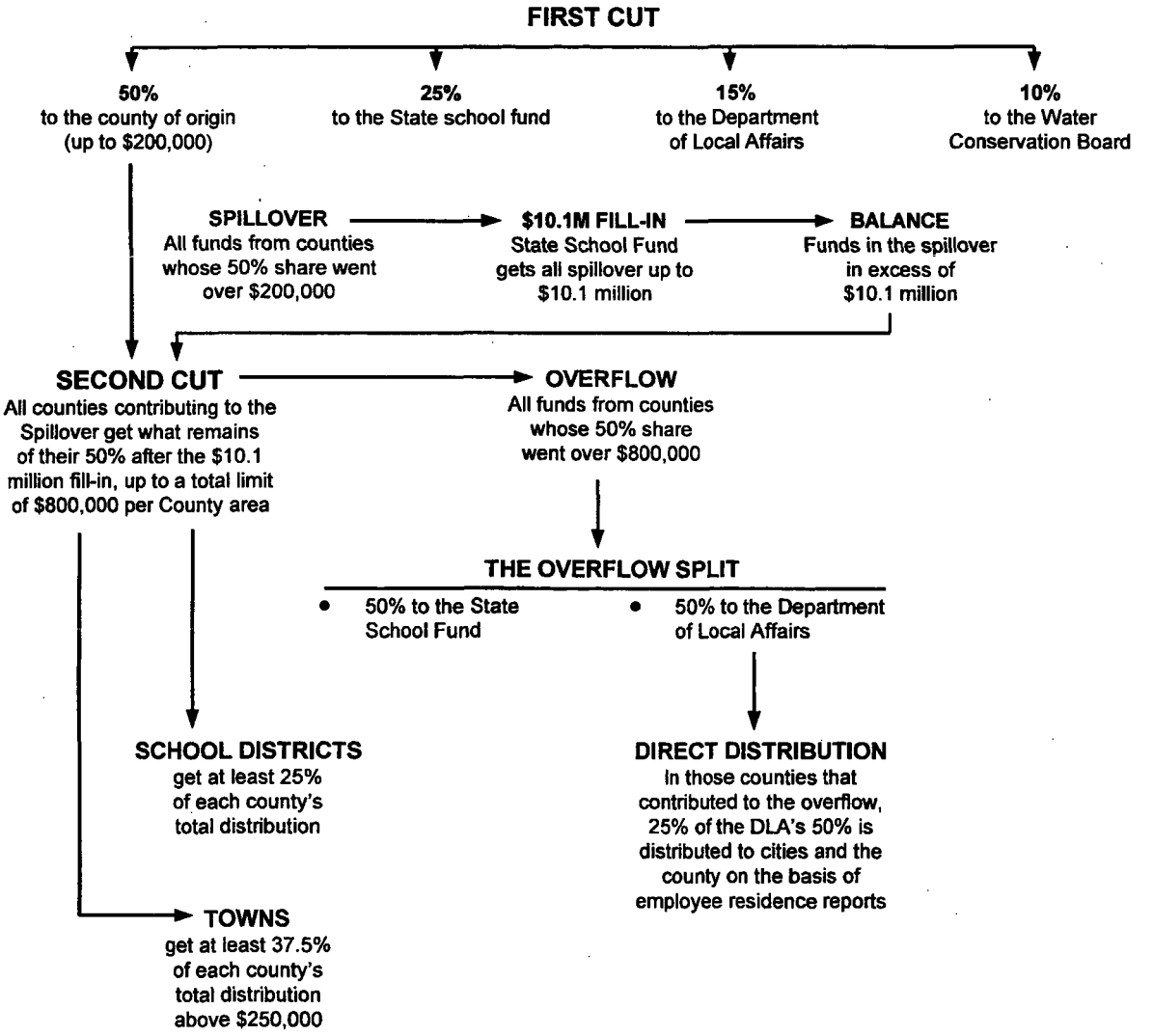
Federal Mineral Lease Distribution

Federal Mineral Leasing Act

- Net of administrative charges, returns. 50% of rents and royalties from Federal lands in the state of origin.
- Directs that funds be used by the states for planning, construction and maintenance of public facilities and services in areas of the state socially and economically impacted by mineral development.

Colorado Mineral Leasing Fund

- Colorado Statute (CRS 34-63-102) directs that distribution prioirty shall be given to school districts and political subdivisions socially or economically impacted by the development or processing of the federal minerals.
- Distributes the amounts originating in each county as reported by the Federal government under the following "cascade" formula.



Appendix L

HAZARDOUS SUBSTANCE MANAGEMENT PLAN

APPENDIX L: HAZARDOUS MATERIALS SUMMARY

This Hazardous Materials Summary is provided pursuant to Bureau of Land Management (BLM) Instruction Memoranda Numbers WO-93-344 and CO-97-023, 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. This summary serves as a supplement to the Glenwood Springs Resource Area Oil & Gas Environmental Impact Statement.

Materials are considered hazardous if they contain chemicals or 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.* Extremely hazardous materials are those identified in the EPA's *List of Extremely Hazardous Substances* (40 Code of Federal Regulations [CFR] 355).

Hazardous materials anticipated to be used or produced during the project may come from drilling materials; cementing and plugging materials; fracturing materials; production products (natural gas, condensates, produced water); fuels and lubricants; pipeline materials; combustion emissions; and miscellaneous materials. Where possible, the quantities of these products or materials have been estimated on a per-well basis. Hazardous and extremely hazardous constituents potentially occurring in these products or materials have been identified and are listed in Table L-1.

Drilling Materials

Water-based drilling fluids consisting of clays and other additives would be utilized by drilling companies for drilling each well. The polyacrylamides used in drilling may contain the extremely hazardous substance acrylamide. Drilling fluid additives would be transported to well locations during drilling operations in appropriate sacks and containers. Drilling fluids, cuttings, and water would be stored in reserve pits located on-site, and reserve pits would be lined as directed by the BLM to conserve water and protect near-surface aquifers. 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.

Cementing and Plugging Materials

Well completion and abandonment operations include cementing and plugging various segments of the well bore to protect freshwater aquifers and other down-hole resources. Wells would be cased and cemented as approved by the BLM (for federal minerals), and Colorado Oil and Gas Conservation Commission (COGCC) (for state and patented minerals). The extremely hazardous material acrylamide may be present in fluid loss additives. All casing and plugging materials would be transported in bulk to each well site. Small quantities may be transported and stored on-site in appropriate containers.

Fracturing Materials

Hydraulic fracturing is expected to be performed at all proposed wells to enhance gas flow rates. Fracturing fluids consist primarily of fresh water, but would contain some additives with hazardous constituents. Fracturing materials would be transported to well locations in bulk or in manufacturer's containers. Waste fracturing fluids would be collected in above-ground tanks and/or reserve pits and evaporated, or hauled away from the location and reused at another well or disposed of at an authorized facility.

Production Products

The purpose of the proposed project is to extract natural gas and oil. Water would also be produced as a by-product.

The primary product of the wells would be natural gas, primarily containing methane and

ethane. No extremely hazardous substances are anticipated to be produced with the gas stream; however, the hazardous substance hexane would be present in the gas stream. 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 gas would be transported from each location via pipeline. The natural gas would eventually be delivered to consumers for combustion. Small quantities of 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 and COGCC rules and regulations (Notice to Lessees [NTL]-4A). BLM and COGCC approval would be obtained prior to flaring or venting operations.

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 polycyclic organic matter and polynuclear aromatic hydrocarbons. No other hazardous or extremely hazardous substances are known to be present in the condensates.

Produced water would be stored in tanks at well locations and transported by truck to permitted disposal facilities.

Fuels and Lubricants

Fuels and lubricants would be used during all stages of the project for the operation of vehicles and equipment.

Gasoline would be used to power motor vehicles. Leaded gasoline contains tetraethyl lead, which is listed as an extremely hazardous substance. Gasoline would be purchased 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.

Diesel fuel would be used to power transport vehicles, drilling rigs, workover rigs, and construction equipment, and as a component of fracturing fluids. During drilling operations, each well location would have an above-ground storage tank containing diesel fuel. 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.

Natural gas would be used to power pipeline compressor stations.

Various lubricants including motor oils, hydraulic oils, transmission oils, compressor lube oils, and greases, would be utilized for project-required vehicles, rigs, compressors, and other machinery. Some of these lubricants would likely contain various hazardous substances. No extremely hazardous substances are known to be present in the lubricants required for the proposed project. The exact quantity of each lubricant used, stored, transported, and disposed of is unknown.

Pipeline Materials

Gas produced from wells would be transported from each location through pipelines. 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. All necessary authorizing actions for natural gas pipelines would be addressed prior to installation.

Materials utilized for pipeline construction, operation, and maintenance that may contain hazardous materials would be handled in accordance with applicable state and federal regulations.

Combustion Emissions

Combustion emissions from gasoline and diesel engines, as well as flaring natural gas, would 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 trioxide and sulfur dioxide would be expected as direct exhaust contaminants. Secondary contaminants would likely include the formation of ozone from the photolysis of nitrogen oxides. Nitrogen dioxide, sulfur dioxide, sulfur trioxide, and ozone are classified as extremely hazardous substances.

Miscellaneous Materials

Miscellaneous materials potentially containing hazardous substances that may be used for the proposed project are listed in Table L-1. Quantities are unknown; however, no extremely hazardous substances are known to be present in any of these materials. Miscellaneous materials would be used during geophysical survey operations; well construction and production operations; well, pipeline, and equipment maintenance; and reclamation activities.

Table L-1 Hazardous and Extremely Hazardous Materials
potentially utilized or produced during construction, drilling, production, and reclamation operations

Source	Approximate Quantities Used or Produced per Well[1]	Hazardous Substances[2]	Extremely Hazardous Substances[3]	CAS No.
Drilling Materials				
Barite	16,000 lbs	Barium compounds Fine mineral fibers		— —
Bentonite	45,000 lbs	Fine mineral fibers		—
Caustic soda	750 lbs	Sodium hydroxide		1310-73-2
Glutaraldehyde	20 gal	Isopropyl alcohol		67-63-0
Lime	3,500 lbs	Calcium hydroxide		1305-62-0
Mica	600 lbs	Fine mineral fibers		—
Modified tannin	250 lbs	Ferrous sulfate Fine mineral fibers		7720-78-7 —
Phosphate esters	100 gals	Methanol		67-56-1
Polyacrylamides	100 gals	PAHs[4] Petroleum distillates POM[5]	Acrylamide	79-06-1 — 64742-47-8 —
Retarder	400 lbs	Fine mineral fibers		—

APPENDIX L: HAZARDOUS MATERIALS SUMMARY

Source	Approximate Quantities Used or Produced per Well[1]	Hazardous Substances[2]	Extremely Hazardous Substances[3]	CAS No.
Cementing and Plugging Materials				
Anti-foamer	100 lbs	Glycol ethers		—
Calcium chloride flake	2,500 lbs	Fine mineral fibers		—
Cellophane flake	300 lbs	Fine mineral fibers		—
Cements	77,000 lbs	Aluminum oxide Fine mineral fibers		1344-2-1 —
Chemical wash	850 gals	Ammonium hydroxide Glycol ethers		1336-21-6 —
Diatomaceous earth	1,000 lbs	Fine mineral fibers		—
Extenders	17,500 lbs	Aluminum oxide Fine mineral fibers		1344-28-1 —
Fluid loss additive	900 lbs	Fine mineral fibers Napthalene	Acrylamide	79-06-1 — 91-20-3
Friction reducer	160 lbs	Fine mineral fibers Napathalene PAHs POM		— 91-20-3 — —
Mud flash	250 lbs	Fine mineral fibers		—
Retarder	100 lbs	Fine mineral fibers		—
Salt	2,570 lbs	Fine mineral fibers		—
Silica flour	4,800 lbs	Fine mineral fibers		—
Fracturing Materials				
Biocides	6 gals	Fine mineral fibers PAHs POM		— — —
Breakers	145 lbs	Ammonium persulphate Ammonium sulphate Copper compounds Ethylene glycol Fine mineral fibers Glycol ethers		7727-54-0 7783-20-2 — 107-21-1 — —
Clay stabilizer	50 gals	Fine mineral fibers Glycol ethers Isopropyl alcohol Methanol PAHs POM		— — 67-63-0 67-56-1 — —
Crosslinkers	60 gals	Ammonium chloride Methanol Potassium hydroxide Zirconium nitrate Zirconium sulfate		12125-02-9 67-56-1 1310-58-3 13746-89-9 14644-61-2
Foaming agent	120 gals	Glycol ethers		—
Gelling agent	950 gals	Benzene Ethylbenzene Methyl tert-butyl ether		71-43-2 100-41-4 1634-04-4

Source	Approximate Quantities Used or Produced per Well[1]	Hazardous Substances[2]	Extremely Hazardous Substances[3]	CAS No.
		Napthalene PAHs POM Sodium Hydroxide Toluene m-Xylene o-Xylene p-Xylene		91-20-3 — — 1310-73-2 108-88-3 108-38-2 95-47-6 106-42-3
pH buffers	60 gals	Acetic acid Benzoid acid Fumaric acid Hydrochloric acid Sodium hydroxide		64-19-7 65-85-0 110-17-8 7647-01-0 1310-73-2
Sands	2,000,000 lbs	Fine mineral fibers		—
Solvents	50 gals	Glycol ethers		—
Surfactants	15 gals	Glycol ethers Isopropyl alcohol Methanol PAHs POM		— 67-63-0 67-56-1 — —
Production Products				
Liquid hydrocarbons	<5-45 bpd	Benzene Ethyl benzene n-Hexane PAHs POM Toluene m-Xylene o-Xylene p-Xylene		71-43-2 100-41-4 110-54-3 — — 108-88-3 108-38-3 95-47-6 106-42-3
Natural gas	0.5>5.0 mmcfd	n-Hexane PAHs POM		110-54-3 — —
Produced water/cuttings	0.5-10 bpd water and an unknown quantity of cuttings	Arsenic Barium Cadmium Chromium Lead Manganese Mercury Radium 226 Selenium Uranium Other radionuclides		7440-38-2 7440-39-3 7440-43-9 7440-47-3 7439-92-1 7439-96-5 7439-97-6 — 7782-49-2 — —

APPENDIX L: HAZARDOUS MATERIALS SUMMARY

Source	Approximate Quantities Used or Produced per Well[1]	Hazardous Substances[2]	Extremely Hazardous Substances[3]	CAS No.
Fuels and Lubricants				
Diesel fuel	>36,300 gal	Benzene Cumene Ethylbenzene Methyl tert-butyl ether Napthalene PAHs POM Toluene m-Xylene o-Xylene p-Xylene		71-43-2 98-82-8 100-41-4 1634-04-4 91-20-3 — — 108-88-3 108-38-3 95-47-6 106-42-3
Gasoline	Unknown	Benzene Cumene Cyclohexane Ethylbenzene n-Hexane Methyl tert-butyl ether Napthalene PAHs POM Toluene m-Xylene o-Xylene p-Xylene	Tetraethyl lead	71-43-2 98-82-8 110-82-7 100-41-4 110-54-3 1634-04-4 91-20-3 — — 78-00-2 108-88-3 108-38-3 95-47-6 106-42-3
Natural gas	Unknown	n-Hexane PAHs POM		110-54-3 — —
Propane	Unknown	Propylene		115-07-1
Lubricants	Unknown	1,2,4-trimethylbenzne Barium Cadmium Copper n-Hexane Lead Manganese Nickel PAHs POM Zinc		94-63-6 7440-39-3 7440-43-9 7440-50-8 110-54-3 7439-92-1 7439-96-5 7440-02-0 — — 7440-66-6
Pipeline Materials				
Coating	Unknown	Aluminum Oxide		1334-28-1
Cupric sulfate solution	Unknown	Cupric sulfate Sulfuric acid		7758-98-7 7664-93-9
Diethanolamine	Unknown	Diathanolamine		111-42-2
LP Gas	Unknown	Benzene n-Hexane Propylene		71-43-2 110-54-3 115-07-1
Molecular sieves	Unknown	Aluminum oxide		1344-28-1
Pipeline primer	Unknown	Napthalene Toluene		91-20-3 108-88-3

Source	Approximate Quantities Used or Produced per Well[1]	Hazardous Substances[2]	Extremely Hazardous Substances[3]	CAS No.
Potassium hydroxide solution	Unknown	Potassium hydroxide		1310-58-3
Rubber resin coatings	Unknown	Acetone Coal tar pitch Ethyl acetate Methyl ethyl ketone Toluene Xylene		67-64-1 68187-65-5 141-78-6 78-93-3 108-88-3 1330-2-07
Combustion Emissions				
Gases	127 tons[6]	Formaldehyde	Nitrogen dioxide Ozone Sulfur dioxide Sulfur trioxide	50-00-0 10102-44-0 10028-15-6 7446-09-5 7446-11-9
Hydrocarbons	492 tons[7]	Benzene Ethylbenzene n-Hexane PAHs Toluene m-Xylene o-Xylene p-Xylene		71-43-2 100-41-4 100-54-3 — 108-88-3 108-38-3 95-47-6 106-42-3
Particulate matter	24 tons[8]	Barium Cadmium Copper Fine mineral fibers Lead Manganese Nickel POM Zinc		7440-39-3 7440-43-9 7440-50-8 — 7439-92-1 7493-96-5 7440-02-0 — 7440-66-6
Miscellaneous Materials				
Acids	Unknown	Acetic anhydride Formic acid Sodium chromate Sulfuric acid		108-24-7 65-18-6 777-11-3 7664-93-09
Antifreeze, heat control, and dehydration agents	300 gals	Acrolein Cupric sulfate Ethylene glycol Freon Phosphoric acid Potassium hydroxide Sodium hydroxide Triethylene glycol		107-02-8 7758-38-7 107-21-1 76-13-1 766-38-2 1310-58-3 1310-73-2 112-27-6
Batteries	Unknown	Cadmium Cadmium oxide Lead Nickel Hydroxide Potassium hydroxide Sulfuric acid		7440-43-0 1306-19-0 7493-92-1 7440-02-0 1310-58-3 7664-93-9
Biocides	Unknown	Formaldehyde Isopropyl alcohol Methanol		50-00-0 67-63-0 67-56-1
Cleaners	Unknown	Hdrochloric acid		7647-01-0

Source	Approximate Quantities Used or Produced per Well[1]	Hazardous Substances[2]	Extremely Hazardous Substances[3]	CAS No.
Corrosion inhibitors	Unknown	4-4' methylene dianiline Acetic acid Ammonium bisulfite Basic zinc carbonate Diethylamine Dodecylbenzenesulfon ic acid Ethylene glycol Isobutyl alcohol Isopropyl alcohol Methanol Napthalene Sodium nitrite Toluene Xylene		101-77-9 64-19-7 10192-30-0 3486-35-9 109-89-7 27176-87-0 107-21-1 78-83-1 67-63-0 67-56-1 91-20-3 7632-00-0 108-88-3 1330-20-7
Emulsion breakers	Unknown	Acetic acid Acetone Ammnium chloride Benzoic acid Ispropyl alcohol Methanol Napthalene Toluene Xylene Zinc chloride		64-19-7 67-64-1 12125-02-9 65-85-0 67-63-0 67-56-1 91-20-3 108-88-3 1330-20-7 7646-85-7
Explosives, fuses, detonators, boosters, fuels	Unknown	Aluminum Ammonium nitrate Benzene Cumene Ethylbenzene Ethylene glycol Lead compounds Methyl tert-butyl ether Napthalene Nitric acid Nitroglycerine PAHs POM Toluene m-Xylene o-Xylene p-Xylene		7429-90-5 6484-52-2 71-43-2 98-82-8 100-41-4 107-21-1 7439-92-1 1634-04-4 91-20-3 7697-37-2 55-63-0 — — 108-88-3 108-38-3 95-47-6 106-42-3
Fertilizers	Unknown	Unknown		—
Herbicides	Unknown	Unknown		—
Lead-free thread compound	25 gals	Copper Zinc		7440-50-8 7440-66-6
Paraffin control	Unknown	Carbon disulfide Ethylbenzene Methanol Toluene Xylene		75-15-0 100-41-4 67-56-1 108-88-3 1330-20-7
Methanol	200 gals	Mdethanol		67-56-1
Motor oil	220 gals	Zinc compounds		—
Paints	Unknown	Aluminum Barium		7429-90-5 7440-39-3

APPENDIX L: HAZARDOUS MATERIALS SUMMARY

Source	Approximate Quantities Used or Produced per Well[1]	Hazardous Substances[2]	Extremely Hazardous Substances[3]	CAS No.
Paints		n-Butyl alcohol Cobalt Lead Manganese PAHs POM Sulfuric acid Toluene Triethylamine Xylene		71-36-3 7440-48-4 7439-92-1 7439-96-5 — — 7664-93-9 108-88-3 121-44-8 1330-20-7
Photoreceptors	Unknown	Selenium		7782-49-2
Scale inhibitors	Unknown	Acetic acid Ethylene diamine tetra Ethylene glycol Formaldehyde Hydrochloric acid Isopropyl alcohol Methanol Nitrilotriacetic acid		64-19-7 60-00-4 107-21-1 50-00-0 7647-01-0 67-63-1 67-56-1 139-13-9
Sealants	Unknown	1,1,1-trichloroethane n-Hexane PAHs POM		71-55-6 110-54-3 — —
Solvents	Unknown	1,1,1-trichloroethane Acetone t-Butyl alcohol Carbontetrachloride Isopropyl alcohol Methyl ethyl ketone Methanol PAHs POM Toluene Xylene		71-55-6 67-64-1 75-65-0 56-23-5 67-63-0 108-10-1 67-56-1 — — 108-88-3 1330-20-7
Starting fluid	Unknown	Ethyl ether		60-29-7
Surfactants	Unknown	Ethylene diamine Isopropyl alcohol Petroleum naptha		107-15-3 67-56-1 8030-30-6

1 lbs = pounds; gals = gallons; bpd = barrels per day; mmcfd = million cubic feet per day; Unknown = unknown quantities to be listed based on information availability.

2 Hazardous substances are those constituents listed under the Consolidated List of Chemicals Subject to Reporting Under Title III of the Superfund Amendments and Reauthorization Act (SARA) of 1986, as amended.

3 Extremely hazardous substances are those defined in 40 CFR 355.

4 PAHs = polynuclear aromatic hydrocarbons.

5 POM = polycryclic organic matter.

6 Value includes NO_2 (107 tons per well) and SO^2 (20 tons per well) estimates only, as adapted from BLM (1996b).

7 Value includes volatile organic compound emission estimates only, as adapted from BLM (1996b).

8 Value includes PM_{10} emission estimates only, as adapted from BLM (1996b).

Appendix M

FISH AND WILDLIFE SERVICE CONSULTATION

APPENDIX M: FISH AND WILDLIFE SERVICE CONSULTATION

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Glenwood Springs Resource Area
50629 Highway 6 and 24
P.O. Box 1009
Glenwood Springs, Colorado 81602

IN REPLY REFER TO:

January 22, 1998

To: Acting Assistant Field Supervisor, USF&WS

From: Area Manager, Glenwood Springs Resource Area

Subject: Oil and Gas Supplemental EIS

The Glenwood Springs Resource Area (GSRA) is currently developing a supplemental Environmental Impact Statement (EIS) on oil and gas development in the GSRA. BLM originally completed the Colorado Oil and Gas Leasing and Development EIS (COGEIS) in 1991. Since then, it has become apparent that actual development in the GSRA will exceed the level evaluated in that document in the near future. The supplemental document will modify the original EIS by describing the impacts of the higher level of development we are currently experiences and anticipate to continue into the future.

The supplemental EIS will include the entire GSRA, but will focus on the area known as Region 4 (see map). Additionally, the EIS will include the developed portion of the Naval Oil Shale Reserve (NOSR) that was mandated by Congress to be leased within one year of the signing of Public Law 105-85 (November 18, 1997).

In order to ensure that we adequately assess impacts to Threatened and Endangered species in the EIS, we are requesting a species list for those listed and candidate species likely to be found in the GSRA, particularly those in Region 4, which includes the NOSR.

We plan to address impacts to T&E species in a similar manner as the COGEIS, in which formal consultation was deferred to the Plan of Development (POD) or Application for Permit to Drill (APD) stage with the exception of the endangered Colorado River fishes. As we develop our scenario for the number of wells anticipated to be drilled over the life of the EIS, we sill determine the average annual depletion volume and initiate the appropriate consultation with your office at that time.

Thank you for your assistance in this matter. If you have any questions, please contact Sue Moyer of our Grand Junction office at (970) 244-3074.

Stephen R. Moore
for Michael Mottice
Area Manager

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Glenwood Springs Resource Area
50629 Highway 6 and 24
P.O. Box 1009
Glenwood Springs, Colorado 81602

IN REPLY REFER TO:

April 21, 1998

To: Acting Assistant Field Supervisor, USF&WS

From: Area Manager, Glenwood Springs Resource Area

Subject: Oil and Gas Supplemental EIS

As stated in our memo of January 22, 1998, the Glenwood Springs Resource Area (GSRA) is developing a supplemental Environmental Impact Statement (EIS) on oil and gas development in the Resource Area. Our previous EIS, the Colorado Oil and Gas Leasing and Development EIS (COGEIS) was completed in 1991 and was anticipated to have a life of approximately 20 years. However, development in the GSRA has already reached the number of wells analyzed in that document. The supplemental EIS will modify the original EIS by describing the impacts of the higher level of development that we are currently experiencing and that we anticipate to continue into the future.

We have recently developed a scenario detailing the number of wells that could be drilled on Federal minerals over the twenty-year timeframe analyzed in the supplemental EIS. An average of 15 wells per year on Federal mineral estate results in three hundred wells over 20 years . Obviously some years we will permit more than 15 wells and in others, less. The 15 well figure was derived from the average number of wells drilled over the last 5 years, a period of increased production in the GSRA, projected into the future.

In order to get an accurate picture of water depletion associated with drilling and completing wells in Region 4 (the area within GSRA that has the highest potential of oil and gas activity - see the attached map), we contacted two of the most active companies in this area (Barrett Resources Corporation and Tom Brown Inc.) and asked for figures on water usage. Both companies reported using approximately 20,000 barrels of water to drill and complete a gas well in this area. This number corresponds to 2.58 acre feet per well.

If you multiply the average figure of 2.58 acre feet per well times the annual average number of wells expected over the next 20 years (15), the resulting figure of 38.7 acre feet would be the average annual depletion amount.

The US Fish and Wildlife Service has determined that any federal actions which result in a water depletion, automatically require a "may affect" determination on the Razorback sucker, Colorado squawfish, Humpback chub and Bonytail. We are therefore requesting formal

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
Western Colorado Office
764 Horizon Drive, South Annex A
Grand Junction, Colorado 81506-3946

IN REPLY REFER TO:

ES/CO:BLM
MS 65412 GJ

February 23, 1998

Memorandum

To: Area Manager, Bureau of Land Management, Glenwood Springs Resource Area, Glenwood Springs, Colorado

From: Acting Assistant Field Supervisor, Fish and Wildlife Service, Ecological Services, Grand Junction, Colorado

Subject: Threatened, Endangered, and Candidate Species List

This is in response to your January 22, 1998, correspondence requesting a list of threatened, endangered and candidate Species that could occur within the Glenwood Springs Resource Area. To comply with section 7(c) of the Endangered Species Act of 1973, as amended, Federal agencies or their designees are required to obtain from the Service information concerning any species or critical habitat, listed or proposed to be listed, which may be present in the area of a proposed construction project. Therefore, we are furnishing you the following list of species which may be present in the concerned area:

FEDERALLY LISTED SPECIES

Black-footed ferret	*Mustela nigripes*
Peregrine falcon	*Falco peregrinus*
Bald eagle	*Haliaeetus leucocephalus*
Whooping crane	*Grus americana*
Mexican spotted owl	*Strix occidentalis lucida*
Southwestern willow flycatcher	*Empidonax traillii extimus*
Razorback sucker	*Xyrauchen texanus*
Colorado squawfish	*Ptychocheilus lucius*
Humpback chub	*Gila cypha*
Bonytail	*Gila elegans*
Sclerocactus glaucus	Uinta Basin hookless cactus

We would like to bring to your attention species which are candidates for official listing as threatened or endangered species (Federal Register, Vol. 62, No. 182, September 19, 1997). While these species presently have no legal protection under the Endangered Species Act, it is within the spirit of the Act to consider project impacts to potentially sensitive candidate species. Additionally, we wish to make you aware of the presence of Federal candidates should any be proposed or listed prior to the time that all Federal actions related to the project are completed.

FEDERAL CANDIDATE SPECIES

Boreal toad	*Bufo boreas boreas*
Penstemon debilis	Parachute penstemon

If the Service can be of further assistance, please contact Kurt Broderdorp at the letterhead address or (970) 243-2778.

cc: CDOW, Grand Junction
FWS/ES, Lakewood

KBroderdorp:BLMGS.SL:022398